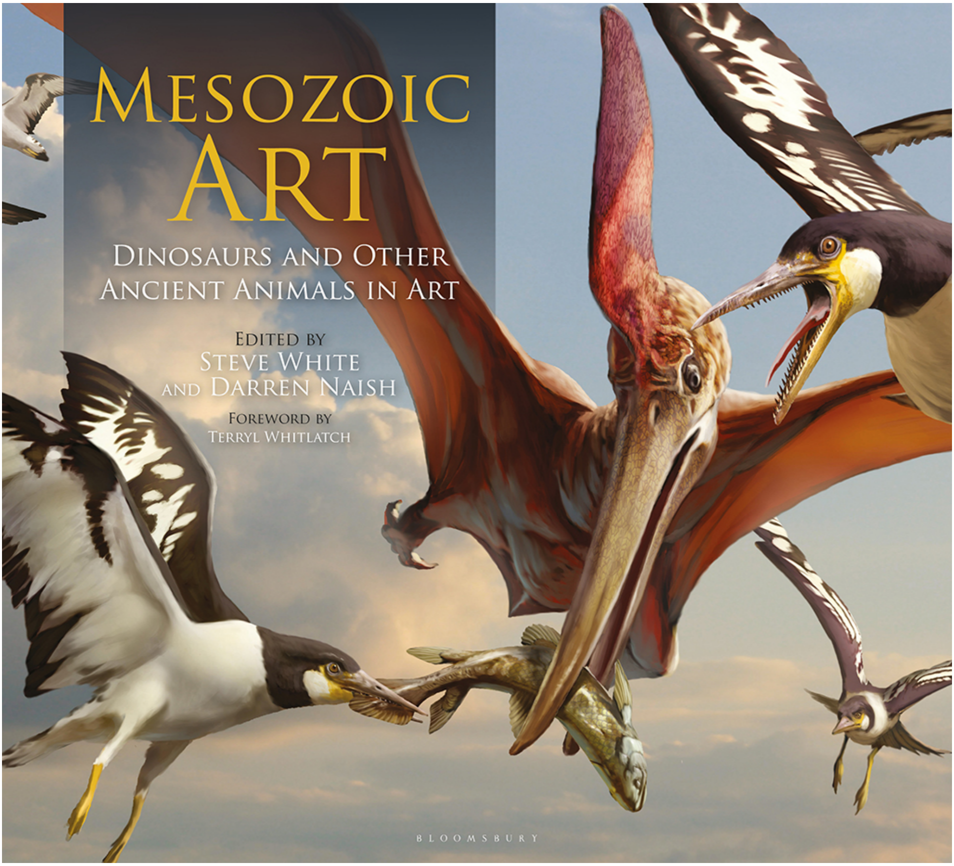

MESOZOIC ART

DINOSAURS AND OTHER ANCIENT ANIMALS IN ART

EDITED BY
STEVE WHITE
AND DARREN NAISH

FOREWORD BY
TERRYL WHITLATCH

BLOOMSBURY

MESOZOIC ART

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BLOOMSBURY WILDLIFE
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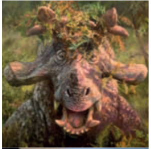
CONTENTS

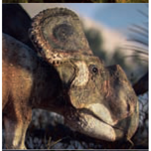
FOREWORD BY TERRYL WHITLATCH

INTRODUCTION

GABRIEL UGUETO

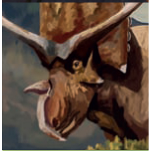


EMILIANO TROCO

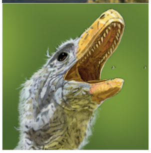


JOANNA KOBIERSKA

JOHN CONWAY



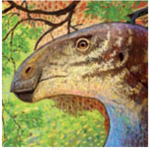
BRENNAN STOKKER- MANS



CORBIN RAINBOLT

JÚLIA D’OLIVEIRA

JOSCHUA KNÜPPE



LUCAS ATTWELL

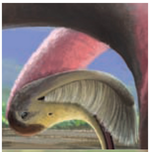
JED TAYLOR

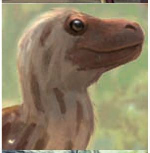
VILLE SINKKONEN

RAVEN AMOS

STEPHANIE DZIEZYK

MIDIAOU DIALLO

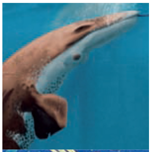




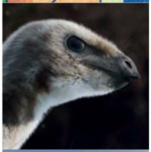
PABLO RIVERA

DANIELLE DUFAULT

MARK WITTON



GREER STOTHERS

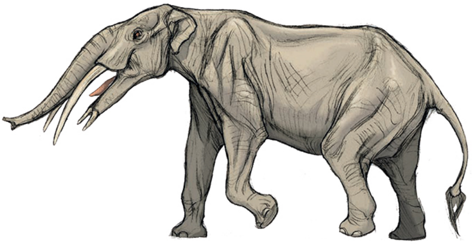


JULIO LACERDA

JAIME CHIRINOS

ACKNOWLEDGEMENTS

TERRYL WHITLATCH is an artist and author best known for her work designing the many creatures and alien species that appeared in *Star Wars: The Phantom Menace*, work that was gathered into a single acclaimed volume, *The Wildlife of Star Wars*. She has also produced several other highly regarded books on the anatomy of animals both living and extinct, and on the science of creature design; these include *Animals Real and Imagined*, *Science of Creature Design: Understanding Animal Anatomy* and *Principles of Creature Design: Creating Imaginary Animals*. Terryl also created, wrote and illustrated the animal fantasy story, *The Katurran Odyssey*.



FOREWORD

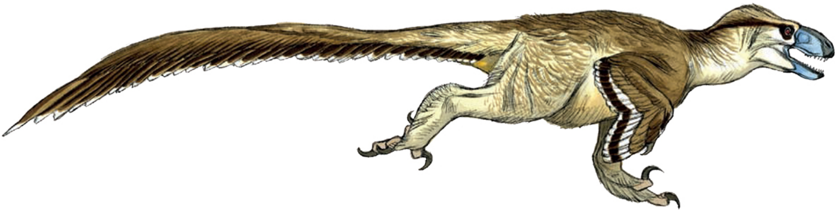
WILDLIFE ILLUSTRATION. At its very best, it's the attempt by human artists to look through the lens of the animals themselves, on their own terms, as they live their lives in nature. Indeed, there are those predator–prey relationships which cannot be denied, and which are crucial to the balance of life on Earth, but that's not all of it. To quote the prominent scientist Temple Grandin, 'Nature can be very cruel – but we don't have to be'; after procuring the subsistence necessary for life, nearly all species on Earth seek a peaceful existence, with man being the exception.

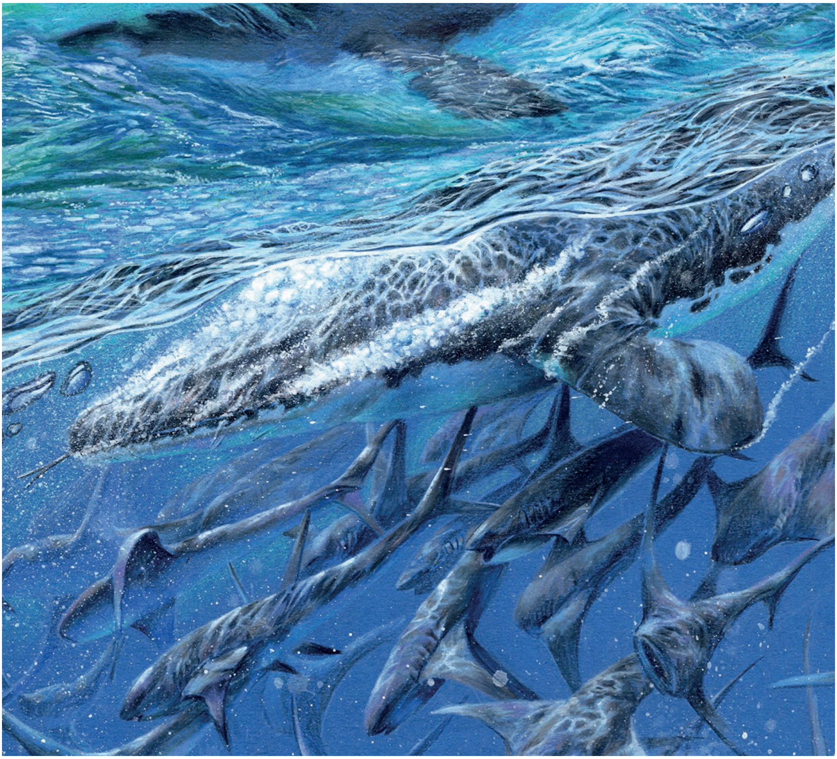
Thus, this book is not a spectator-sport vision of *Nature Red in Tooth and Claw*, but a marvellous window to the world of animals – animals living their lives – that crosses time and space to dive into the Mesozoic Era: a long ago time when dinosaurs roamed the Earth, birds were attaining flight, and the first mammals were poking about, looking for all kinds of opportunities to take advantage of, as mammals always do.

These are images inspired not only by the fossil record, but by the living descendants of those ancient beings – in behaviour, anatomy, colour, feather shape and structure – phylogenetics that transverse millions of years. Thus, we see courtship rituals, play, travel, migration, child rearing and lazing about. We see colours and patterns that remind us of those that we have observed somewhere before. These are things that endure. Things that we see in our animal companions, at farms, ranches, zoological gardens and wildlife refuges, and in the ominously disappearing wild. I see my two dressage horses nearly every day, and ponder the behavioural and anatomical legacies of *Pliohippus*, *Mesohippus*, and even tiny *Eohippus*, that they display as they interact with their fellow pasture mates. That they willingly seek me out, let alone let me ride them, is truly a miracle.

So, animals always surprise us. They are always so much more than we think them to be or believe they are capable of. They are thinking beings, with emotions and empathy. Things that all the great naturalist–scientists have observed and documented, from James Audubon and Roger Tory Peterson, to Jane Goodall and David Attenborough. And this is what you'll find in this most beautiful book.

TERRYL WHITLATCH
ALBANY, OREGON





INTRODUCTION
THE DINOSAUR ENLIGHTENMENT

AN INTELLECTUAL EVENT known as ‘The Enlightenment’ – a tidal wave of human reasoning and philosophy – swept across Europe in the seventeenth and eighteenth centuries. It was instrumental in the Scientific Revolution, which marked both the birth of modern science and the transformation of humanity’s understanding of nature. The roots of the Enlightenment lay in the Renaissance, the revolution in human thinking that had occurred in the previous two centuries. It is little wonder, then, that the so-called Dinosaur Renaissance of the latter part of the twentieth century has been followed by the equally catchy Dinosaur Enlightenment.

The former, beginning in the late 1960s and then continuing throughout the 1970s and 1980s, saw an almost complete overhaul of our perception of dinosaurs. The Dickensian image of dinosaurs as slow-witted and cumbersome great reptiles, and as evolutionary failures unable to cope with environmental change, was consigned to the scientific dustbin. Concepts, such as dinosaur endothermy, the dinosaurian ancestors of birds, and the extinction event at the end of the Cretaceous, to name but a few, were given life. While some were – and remain – contentious, they have now become more or less accepted as the modern canon.

The beginning of the twenty-first century saw great strides in technology that allowed researchers to further enhance the big picture the Dinosaur Renaissance had created. New digital techniques and computer software helped flesh out, so to speak, the soft-tissue anatomy and life appearance of dinosaurs and many other prehistoric animals; in some cases even providing evidence on the colours of their external coverings. Other advances helped to further our understanding of dinosaur biomechanics via analysis of thorny questions, such as the weight and speed of some species, the physics of movement and how feathered dinosaurs might have flown. Advanced microscopy and scanning techniques helped researchers see inside eggs and construct the embryos within. New data and new study have also helped settle – once and for all – the question regarding the distribution of feathers among non-bird dinosaurs, and also what kind of feathers they had. The speculations of the Dinosaur Renaissance were mostly borne out of this work, though palaeontologists rarely concede this point.

This new scientific revolution also had a profound impact on the art of reconstructing the animals of the ancient past, as well as the ecosystems they populated. The twenty-first century saw the internet grow exponentially and spawn countless communities across the growing empires of social media. The result is a new generation of artists who did not need to rely on books alone to see palaeoart: it is now easy to find material online, the internet itself providing the perfect nexus for the exchange of ideas, methods, critiques and information on a level undreamed of just a couple of decades ago.

Artists no longer need to be published to become well known; many have generated large followings and garnered great popularity on Instagram and Twitter without their artwork ever needing to grace the pages of a book. Some members of this new generation of palaeoartists are featured in this volume, their work appearing here – in print – for the first time.

Palaeoartists' art is also open to review by their peers, for better or for worse, but it does encourage a desire by most artists to aim high in reconstructing their subjects as accurately as possible. Moreover, the broad dissemination of information means palaeoartists find they can apply a magnifying glass to the whole world of the dinosaurs, developing an academically intimate knowledge not just of the dinosaur themselves but also their ecology, and of the amphibians, fish, insects and arthropods that lived alongside them. They may have started out like many artists over previous decades, copying and tracing dinosaurs from books (or now on tablets), but with so much advice and information on hand, many have quickly evolved to become artists of note.

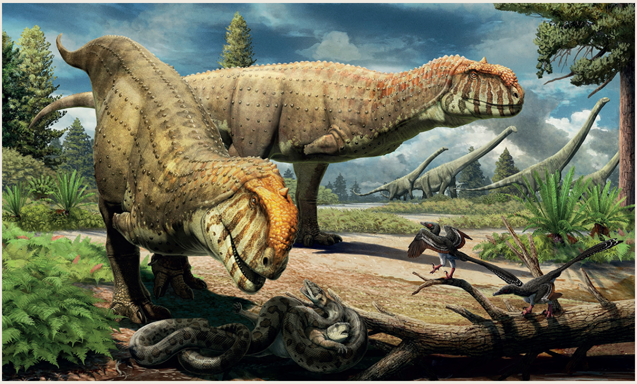
This more all-encompassing approach to the reconstruction of the dinosaurs, and the ancient world as a whole, makes the title of this book more appropriate than it might at first seem. Yes, it should be clear that this book will be enjoyed by those who love dinosaurs. But the artwork showcased here presents so much more than images of dinosaurs alone: this book is also about presenting the world they lived in, and their place in the history of life on this planet.

Finally, a quick note on the time frame covered in this book. We are, of course, aware that some of the artwork we include transgresses the Mesozoic in its subject matter. There are a couple of reasons for this. In some cases, the artists were very particular about their inclusion as they were favourite pieces and this is, after all, their book. In other cases, they were included because of what Darren calls ‘the Mesozoic Eye’. Many palaeoartists (and no doubt a fair few palaeontologists) are prone to view the world through a prehistoric prism, transposing a herd of horses for a herd of hadrosaurs, crocodiles for phytosaurs. The Florida Everglades becomes the bayous of Hell Creek, ice-covered musk-oxen become pachyrhinosaurs in the High Arctic of the Cretaceous, while battling brontotheres could just as easily be fighting *Triceratops*, or, for that matter, white rhinos. As such, we felt illustrations from the Paleozoic and the Cenozoic were worthy of inclusion because, essentially, the more things change, the more they stay the same. You may also notice variations when dating the age of an organism in this book. The designation ‘Early’ or ‘Late’ is used in reference to the chronological age of an animal or plant. A ‘Lower’ or ‘Upper’ designation refers to the geological formation – quite literally the rocks – where a fossil is known from.

DARREN NAISH & STEVE WHITE

USA

GABRIEL UGUETO

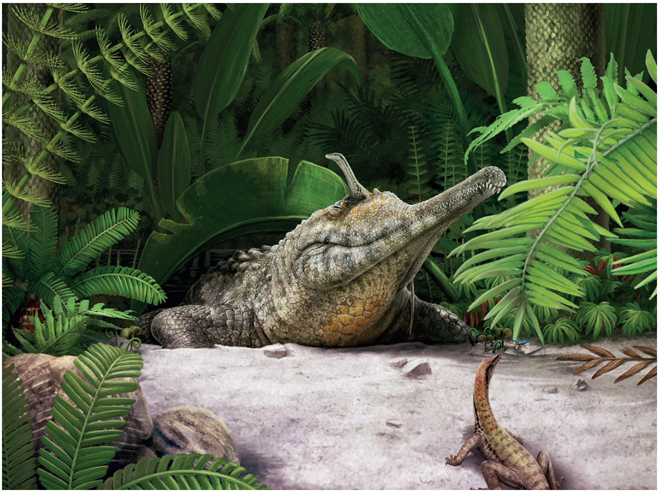


MAJUNGASAURUS **OF MADAGASCAR**
An assemblage of island-dwelling dinosaurs and other animals from Upper Cretaceous Madagascar, including: the abelisaurid theropod *Majungasaurus* (centre); the snake *Madtsoia*, shown here while constricting the archaic mammal *Adalatherium* (bottom); the titanosaur *Rapetosaurus* (background); and the maniraptoran theropod *Rahonavis* (right).

- **Digital | 2021**

BORN IN VENEZUELA, Gabriel moved to Miami, Florida, 23 years ago. He grew up loving reptiles and amphibians and, after studying graphic design and illustration, he worked for several years as an independent herpetological researcher. Studying the systematics and taxonomy of South American herpetofauna, he authored numerous papers, including descriptions of several new species of Neotropical lizards.

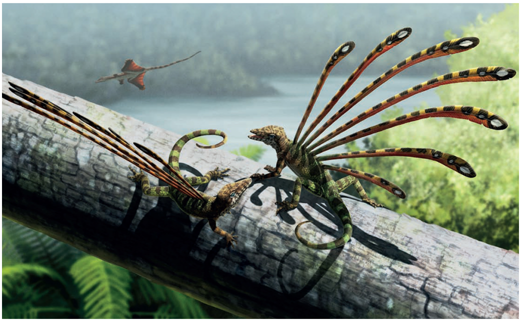
Gabriel began his artistic career as a scientific and natural history illustrator, but a passion for extinct animals made his transition into palaeoart a natural one. His work reflects the latest in scientific thinking regarding the external appearance and behaviour of the animals that he reconstructs, and has featured in several academic papers and palaeontological press releases. He has also provided illustrations for a series of seven books written by Professor Ben Garrod, which tell the story of the major mass extinctions on Earth, and for numerous periodicals, including *National Geographic*. His artwork is exhibited in several institutions worldwide, and he has contributed illustrations and concept art to various online and TV projects for clients, including Science Friday and the BBC.



RUTIODON BASKING

A basking *Rutiodon* – a North American phytosaur – is rudely awoken by the small, long-necked *Tanytrachelos* (one of the strange, often sea-going tanystropheid reptiles, best known of which is the much longer-necked *Tanystropheus*). Phytosaurs superficially recall crocodiles, but differ in possessing nostrils raised on a bony mound close to the eyes. Recent work indicates that phytosaurs are – contrary to tradition – not part of the 'ruling' reptile group Archosauria.

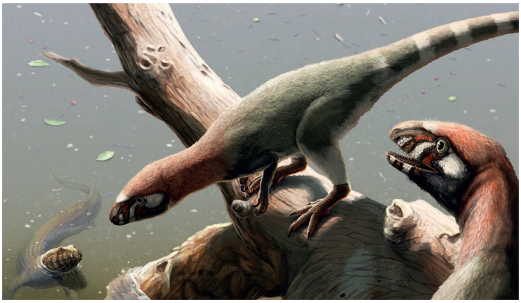
- **Digital | 2019**



LONGISQUAMA DUEL

Longisquama from Kyrgyzstan remains one of the strangest Triassic reptiles, and opinions vary on its anatomy and affinities. Almost nothing is known about its biology, but its small size, and hands that look suited for clinging, suggest tree-dwelling habits. Its flamboyant look – caused not just by its remarkable dorsal appendages but also by a bony head frill and long body scales – suggests structures that it used for display and intimidation.

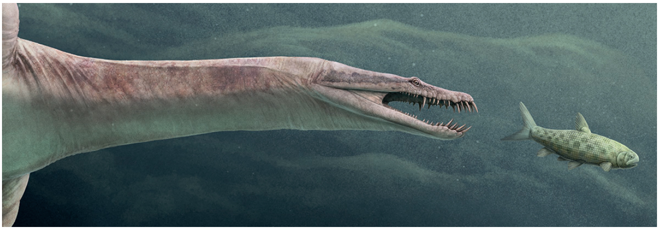
- **Digital | 2021**



VANCLEAVEA* MEETS *DAEMONOSAURUS

A theme explored in several of Gabriel's pieces concerns interaction between Mesozoic reptile species, and not necessarily involving predation. Here, we see the odd, heavily armoured aquatic reptile *Vancleavea* approach the bipedal, theropod-like dinosaur *Daemonosaurus*. Both animals inhabited North America during the Late Triassic. The curious *Daemonosaurus* are perhaps assessing *Vancleavea* as a potential prey item. They might be cautious, however, since some *Vancleavea* reached 4m in length and hence could have posed a real danger to small dinosaurs.

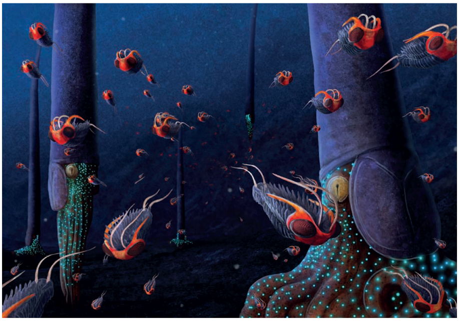
- **Digital | 2019**



NOTHOSAURUS MIRABILIS

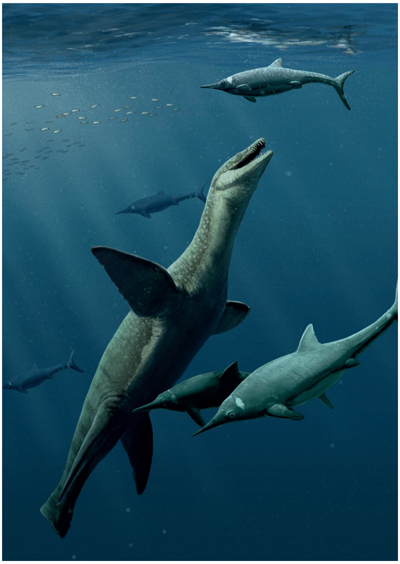
Numerous *Nothosaurus* species (ranging from 1m to more than 6m in length) have been described from the Triassic sediments of Europe, the Middle East and China. A geographically wide-ranging, successful group of animals, their long, interlocking fangs are among the most remarkable teeth that have ever evolved; they were presumably used in grabbing and 'caging' prey in the mouth before swallowing. How nothosaurs are depicted and what skin texture they had remains ambiguous. Here, Gabriel has shown a covering of small, non-overlapping scales.

- **Digital | 2021**



SUBMARINE NEON WAR: *ENDOCERAS* AND *OPIPEUTERELLA*
The seas of the Palaeozoic would have looked alien to modern eyes. *Opipeuterella* was a pelagic, back-swimming trilobite that probably fed on plankton. *Endoceras* was a gigantic (5m long or more) shelled cephalopod (and thus a relative of squid) that probably ambushed passing prey. This illustration was produced for Ben Garrod's book *Trilobites*, part of his *Extinct* series. (Used with permission.)

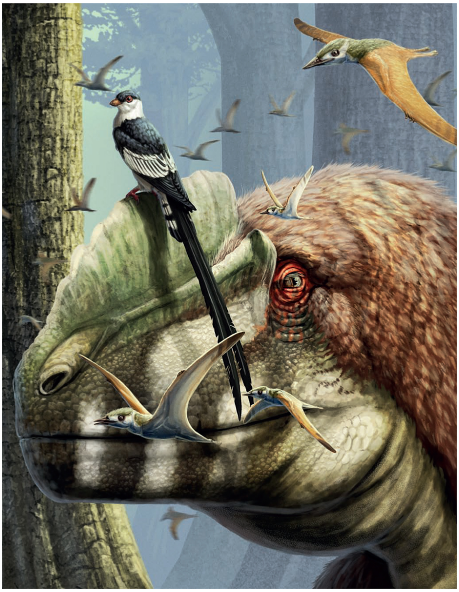
• Digital | 2021



RHOMALEOSAURUS* ATTACKS *HAUFFIOPTERYX

Plesiosaurs were a perpetual presence throughout the seas of the Jurassic and Cretaceous, and giant size and so-called ‘pliosauromorph’ proportions evolved at least three times within the group. The oldest pliosauromorphs are the rhomaleosaurids, a group mostly known from the Early and Middle Jurassic of Western Europe. *Rhomaleosaurus* itself is the biggest and most robustly built of the rhomaleosaurids, and almost certainly would have attacked other marine reptiles like these *Hauffiopteryx*.

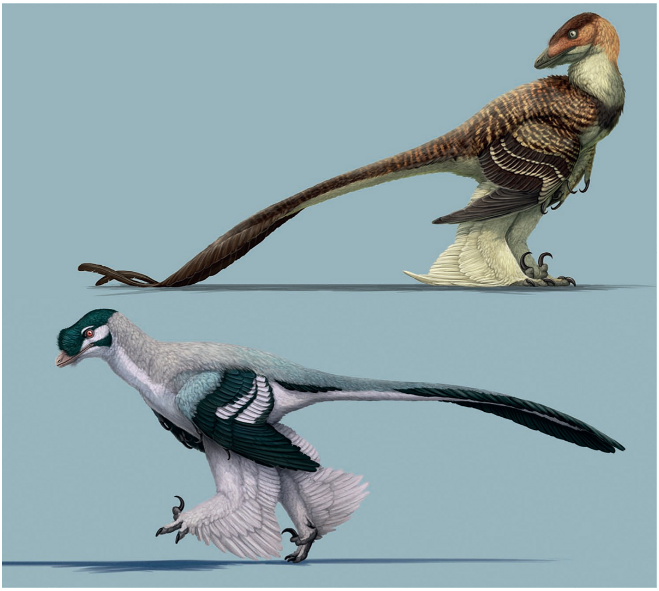
• Digital | 2020



EARLY MORNING IN CRETACEOUS ASIA: *YUANCHUAVIS, SINOPTERUS* AND *SINOTYRANNUS*

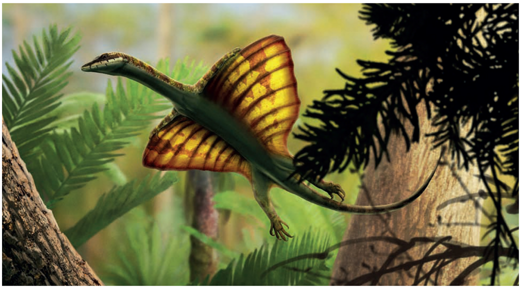
Many Cretaceous fossil assemblages show that pterosaurs and birds shared the same environments and lived alongside many types of large dinosaurs. There can be little doubt these animals interacted, meaning such busy scenes as this are entirely plausible. The long-tailed bird *Yuanchuavis* is a remarkable enantiornithine new to science in 2021, shown here perching on the crest of the large tyrannosauroid *Sinotyrannus*, while a flock of the small pterosaur *Sinopterus* flies by. The flock contains both young and adults; young pterosaurs probably occupied a different ecological niche to their larger parents.

- **Digital | 2021**



SINORNITHOSAURUS **AND** ***GRACILIRAPTOR***
Remarkable fossil discoveries have finally enabled us to confirm the precise configuration of the plumage of various non-bird theropods. Even the anatomy of individual feathers can be observed. For an artist attuned to the portrayal of exact detail – Gabriel's artistic history involves meticulous illustrations of modern snakes and lizards – it only seems natural that such animals are appealing subjects. Shown here are *Sinornithosaurus* and *Graciliraptor*, members of the microraptorine clade within the Dromaeosauridae.

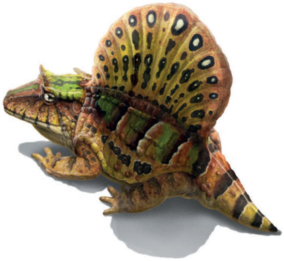
• Digital | 2021



MECISTOTRACHELOS GLIDING

The Triassic includes numerous amazingly odd and diverse reptiles, many of which evolved forms and lifestyles never seen again. *Mecistotrachelos* was described from the United States in 2007. Perhaps 30cm long, its delicate proportions, pointed snout, long neck and rib-supported membranes suggest a climbing lifestyle and gliding ability.

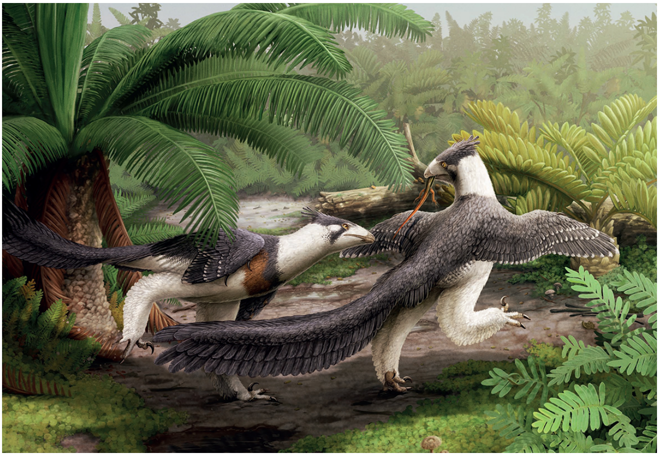
- **Digital | 2020**



PLATYHYSTRIX

The temnospondyls are an important group of amphibians known from the late Palaeozoic and early Mesozoic. *Platyhystrix* is a remarkable dissorophoid temnospondyl from the Carboniferous and Permian of the United States, noted for the tall, laterally flattened bony spines that formed a sail on its back. Recent studies confirm that dissorophoids include the ancestors of modern frogs and salamanders.

- **Digital | 2021**



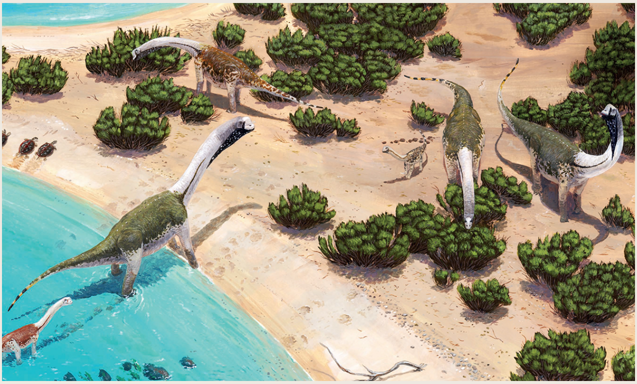
***HESPERORNITHOIDES* PAIR**

The Late Jurassic maniraptoran theropod *Hesperornithoides* – a pheasant-sized North American dinosaur – appears to be an early member of the troodontid family. They were very similar in proportions and plumage to archaic birds (like *Archaeopteryx*). The unfortunate lizard is a paramacellodid, a member of a skink-like group scarcely ever portrayed in palaeoart before.

• Digital | 2019

GERMANY

JOSCHUA KNÜPPE



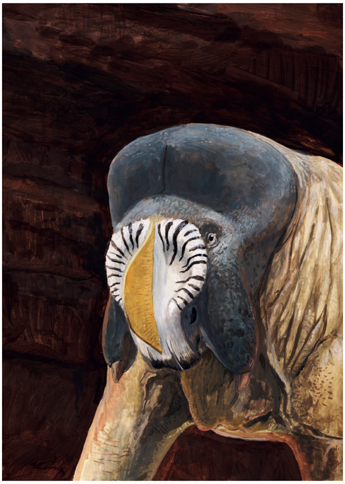
ARRIVAL AT THE FEEDING GROUNDS

This image from Joschua's 2020 graphic novel (co-authored with Oliver Wings) shows a herd of the Late Jurassic *Europasaurus*, a miniature, island-dwelling brachiosaurid. Depicted as elaborately pigmented, the juveniles differ in coloration from their parents. The plants are the salt-tolerant conifer *Brachyphyllum*. Also included is the sea-going turtle *Plesiochelys*.

- **Acrylic, gouache and coloured pencil on paper | 2019**

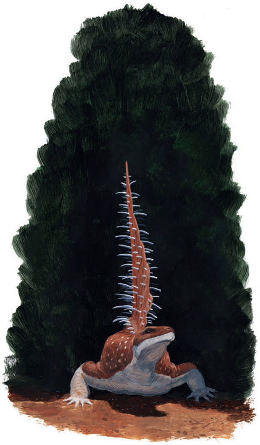
BORN IN 1992, Joschua began drawing on his first day at kindergarten, aged four. Since then, he has studied art at the Academy of Fine Arts Münster, and in 2014 he began his career as a professional palaeoartist, working with scientists and museums. His credits include several exhibitions and panel discussions organised by the European Association of Vertebrate Palaeontologists and producing more than 20 illustrations for the National Museum of Natural History in

Luxembourg. He is perhaps best known for founding the #paleostream community of online artists who produce challenging new art on an almost daily basis; his work from #paleostream has so far been collected into two artbooks. In 2020 he illustrated the graphic novel/picture book *Europasaurus: Life on Jurassic Islands*. He currently lives in Ibbenbüren, Germany.



RECHNISAURUS IN FULL DISPLAY
This painting aims to reconstruct the face of *Rechnisaurus* – a kannemeyeriid dicynodont from the Middle Triassic of India – in a new and surprisingly flamboyant way. Uninhibited by the largely colour-blind condition present in mammals, other branches of the synapsid tree may have had good colour vision and used many colours in behavioural displays.

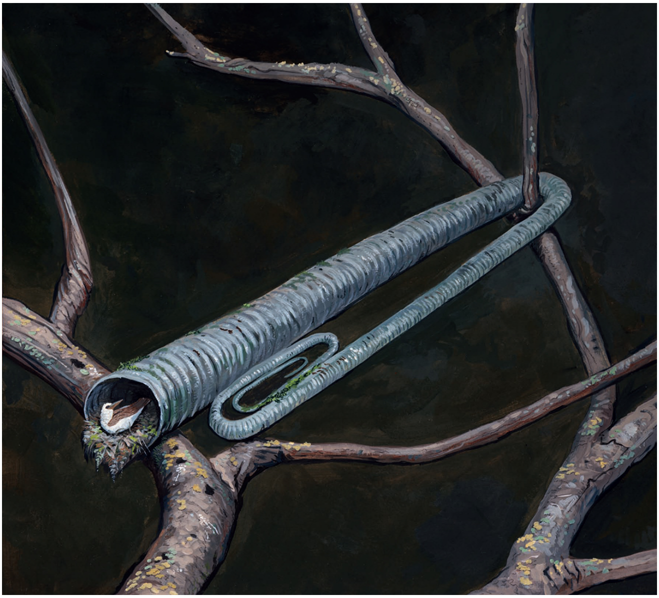
• Acrylic and gouache on paper | 2020



FRONTAL EDAPH

The famous Permo-Carboniferous sail-backed synapsid *Edaphosaurus* is virtually never shown front on. This illustration shows how unusual the animal would have looked – the tall dorsal spines forming its sail possessing lateral protrusions ranging from small knobs to spines several centimetres long. They are depicted here as keratin-sheathed, and thus even bigger than they are in fossils.

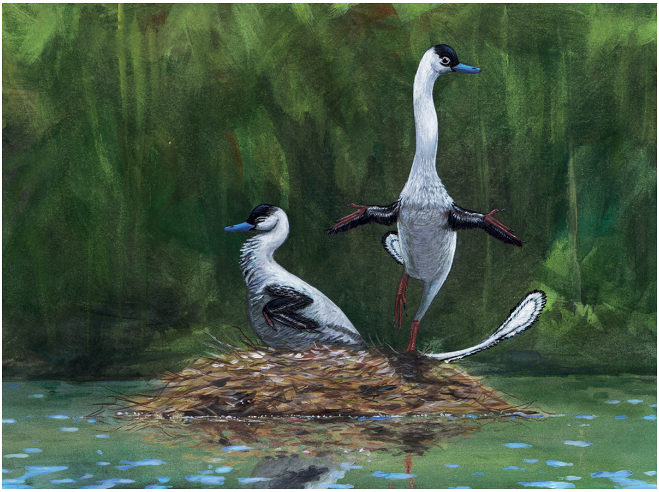
- **Acrylic and gouache on paper | 2021**



DIPLOMOCERAS NEST

The 2m-long Late Cretaceous ammonite *Diplomoceras* had a very unusual paperclip-shaped shell. While little is known of its lifestyle, studies suggest the animal had a lifespan of two centuries or more. In this picture, a storm has thrown a *Diplomoceras* shell into a tree, providing a nesting site for *Vegavis* – an early bird related to modern ducks and geese.

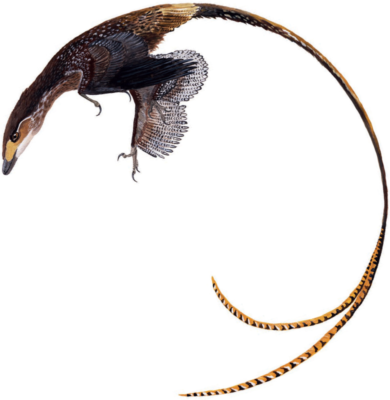
• Acrylic on paper | 2022



A WET NEST

A nesting pair of the semi-aquatic Mongolian dromaeosaurid *Halszkaraptor*. Nothing is known of halszkaraptorine nesting habits, but this behaviour seems reasonable if these animals did indeed have a waterbird-like lifestyle. Joschua heard about this dinosaur the day before its description was due to be published, rushing to the drawing board late in the day and painting until the small hours to complete the work in record time.

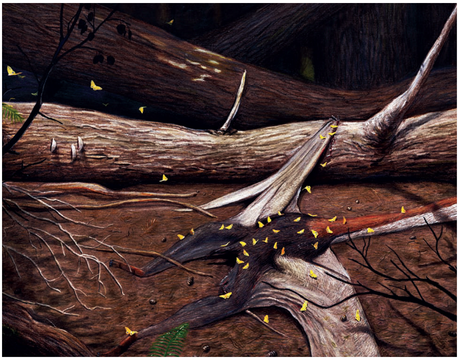
• Acrylic on paper | 2017



WULONG

Joschua learned of the ornate-tailed microraptorine dromaeosaurid *Wulong* in 2014 while at a palaeontological meeting in Berlin, and made sketches of it that he kept secret until the animal was formally described in 2020. The circular composition is an attempt to show off the unusual whole-body shape of this animal.

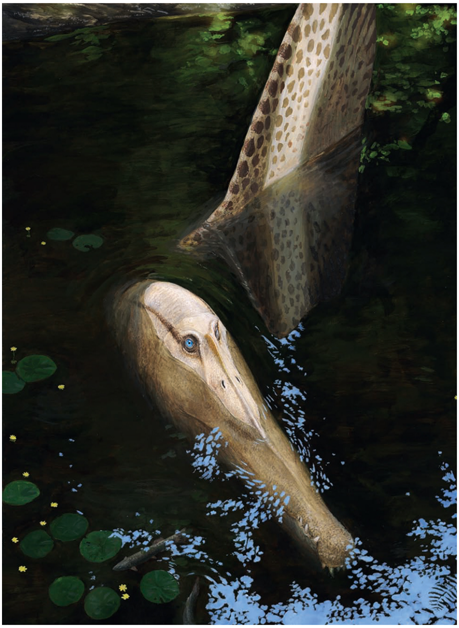
- **Acrylic and gouache on paper | 2020**



A FALLEN GOD

The largest Cretaceous azhdarchid pterosaurs exceeded 10m in wingspan. But no animal lives forever, and a deceased individual would have been a feast for scavengers. Another group of flying animals became airborne while the azhdarchids were around: the lepidopterans; butterflies and moths. While these insects are best known for feeding on nectar, they do feed on other fluids, including those produced during decomposition.

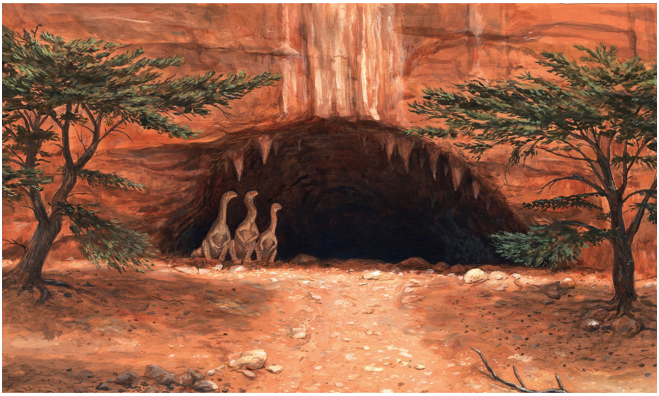
- **Gouache and coloured pencil on brown paper | 2018**



HIDING THE CONTROVERSIAL BITS

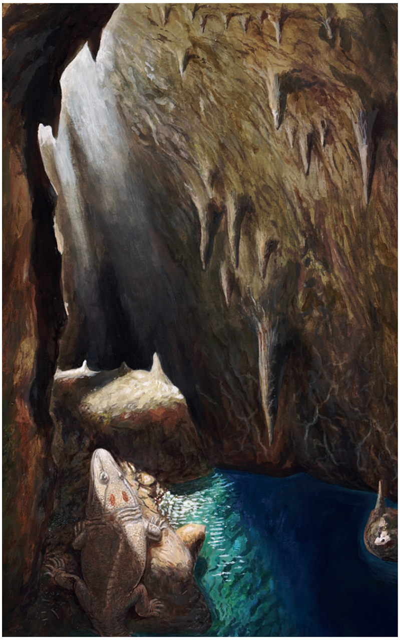
A mostly submerged *Spinosaurus* amidst *Nelumbites* water lilies and the bowfin-like fish *Calamopleurus*. This piece was created to illustrate a paper reporting isolated spinosaurid material from the Upper Cretaceous Kem Kem Group of Morocco, among which is a skull fragment representing the rim of the eye socket. This shows that the eyes might have been raised in a similar fashion to crocodylians. As preparation for this piece, Joschua constructed a model and submerged it in a local stream. This helps explain the convincing portrayal of light, shadow, and the look of the water surface.

- **Acrylic and gouache on paper | 2018**



PANTY CAVE
Numerous fossil vertebrates are known from the Upper Triassic rocks of south-west England and Wales. These animals inhabited a series of islands where their remains collected in caves and fissures. This painting supposes that the sauropodomorph dinosaur *Thecodontosaurus* might have visited caves for shelter or as a source of water. The painting's name is a reference to one of the relevant fossiliferous locations: Pant-y-ffynnon.

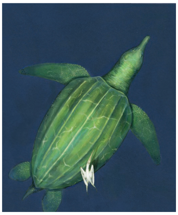
• Acrylic and gouache on paper | 2018



UNTIMELY DEMISE IN RICHARDS SPUR

The large terrestrial temnospondyl *Acheloma* – an animal loosely allied to the ancestors of modern amphibians – has fallen into a cave that has already served as a grave for other animals; on the right, the skull of *Captorhinus*, an early reptile, is being encrusted in limestone. Richards Spur is a fossil-bearing location in Oklahoma, and its many Permian fossils represent the remains of animals that died after being washed into caves or otherwise becoming trapped in them.

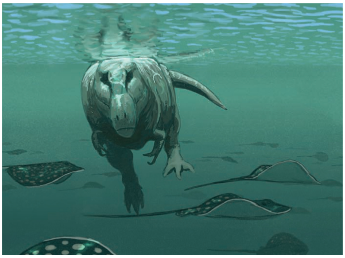
• Acrylic and gouache on paper | 2018



VISITORS

The Upper Cretaceous phosphates of Morocco have turned up numerous exciting new species in recent years, including the giant sea turtle *Ocepechelon*. Its tubular snout appears to have sucked in small prey via a pipette-like action, a feeding behaviour not seen in any other reptile. Among the pterosaurs known from the Moroccan phosphates is the nyctosaurid *Alcione*, an animal probably specialised for kingfisher-like plunging.

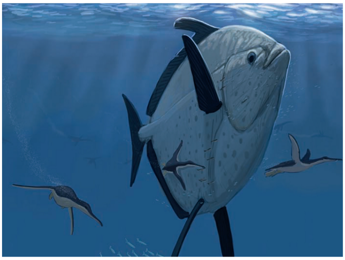
- **Acrylic and gouache on blue paper | 2018**



ZHUCHENGTYRANNUS

Modern animals of essentially all groups are capable of swimming, suggesting that dinosaurs not generally associated with aquatic behaviour – like the Late Cretaceous Chinese tyrannosaurid *Zhuchengtyrannus* – crossed bodies of water on occasion. Rays were highly diverse and abundant during the Cretaceous and the members of most modern lineages had already evolved.

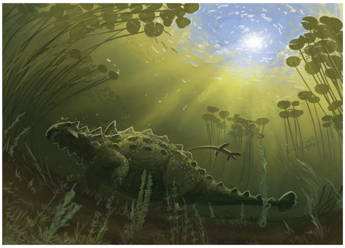
• Digital | 2021



MEGALAMPRIS

Megalampris from the Late Oligocene of New Zealand is a gigantic opah, or moonfish, similar to living opah species but dwarfing them, with a length of around 4m. The *Palaeeudyptes* penguins swimming past appear small, even though they are similar in size to the modern Emperor Penguin.

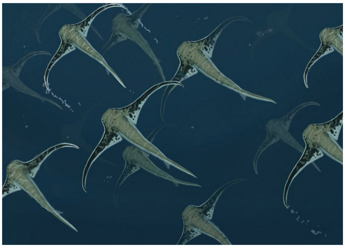
- **Digital | 2021**



EUOPLOCEPHALUS

The idea that certain wide-bodied, vaguely hippo-shaped ankylosaurs were suited for an amphibious lifestyle has been suggested a few times. However, studies indicate that ankylosaurs were negatively buoyant, in which case a *Euoplocephalus* visiting the water might have to punt along the water bottom, hippo-style, as shown here.

• Digital | 2021



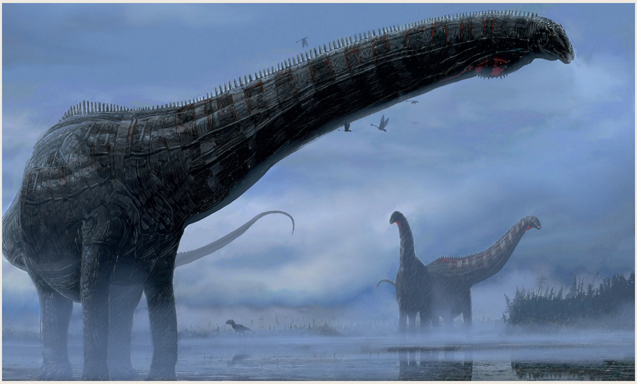
AQUILOLAMNA

Aquilolamna is a highly unusual filter-feeding cartilaginous fish from the Late Cretaceous of Mexico, described in 2021. Despite a vaguely ray-like form, several anatomical details suggest – surprisingly – an affinity with the shark group that includes makos, white sharks and kin.

- **Digital | 2021**

USA

CORBIN RAINBOLT



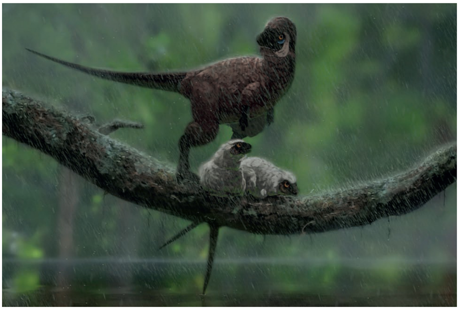
DIPLODOCOIDS

A cloudy, rainy Late Jurassic scene in North America. Giant sauropod dinosaurs like these diplodocoids were no doubt adapted to both strong sunlight and high temperatures, and the cool, rainy conditions that existed for part of the year. The Mesozoic world was not – contrary to stereotype – a perpetual hothouse, but one where seasonal changes sometimes included prominent cold spells. These giant sauropods must often have been out in the open, enduring weathers of all kinds, as wonderfully conveyed here.

- **Digital | 2022**

CORBIN'S INTEREST in palaeoart germinated while flipping through dinosaur books as a youngster, but – despite taking a few art classes at college – he never really considered pursuing this interest much further. Instead, he recently completed his undergraduate course, earning a degree in

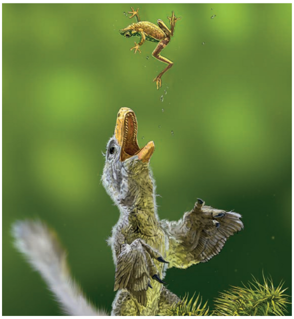
Linguistics, and now works as a teaching assistant in French classes. During his studies, he also worked at his college's student-run natural history museum as part of its exhibition design team. However, following the lockdowns of 2020, Corbin became aware of the current wave of palaeoartists posting their art on Twitter, and with time on his hands he began producing illustrations of his own. As he puts it, 'It turned out to be something I really enjoyed doing and wanted to get better at.' Although new to the genre, his work has made him a rising star and an artist to watch.



***KULINDADROMEUS* FAMILY**

A *Kulindadromeus* adult shelters its chicks during a Middle Jurassic shower in Russia. *Kulindadromeus* – named in 2014 – demonstrates that at least some small ornithischian dinosaurs possessed quill-like fibres and bristles across much of their body. Its tail and parts of its limbs were scale-covered, the rectangular scales on the tail forming a tidily arranged armour-plated look.

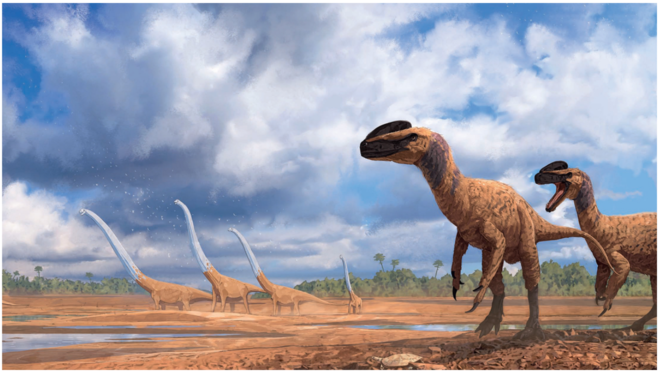
• Digital | 2021



HESPERONYCHUS AND FROG

The Late Cretaceous small dromaeosaurid *Hesperonychus* playing with a frog. Frogs of several groups were present during the Late Cretaceous, no doubt being preyed upon by small theropods and other animals. Indeed, predation pressure encouraged the evolution within the group of noxious chemicals, profound agility and cryptic habits.

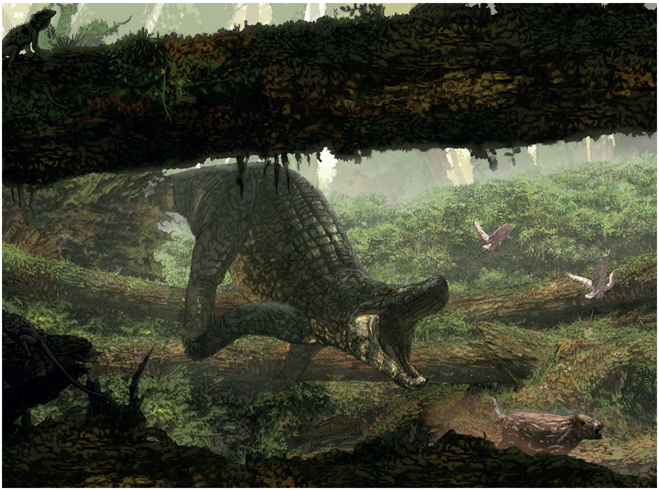
• Digital | 2021



GUANLONG AND *MAMENCHISAURUS*

The Upper Jurassic Shishugou Formation of Xinjiang in north-west China has yielded many dinosaurs – early ceratopsians, sauropods and an array of unusual theropods, including the crested tyrannosauroid *Guanlong*. A few Shishugou sauropods are mega-giants, among them the mamenchisaurid sauropod *Mamenchisaurus sinocanadorum*. It perhaps reached 35m in length; its neck alone was around 18m long. Its mammoth footprints formed circular muddy traps where various small animals – including *Guanlong* – became mired and died.

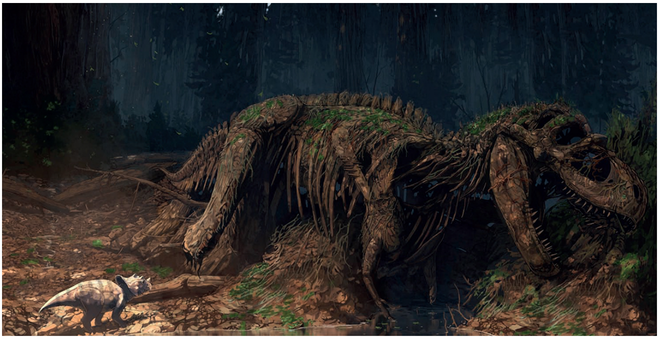
• Digital | 2021



BOVERISUCHUS* AND *PRO PALAEOTHERIUM

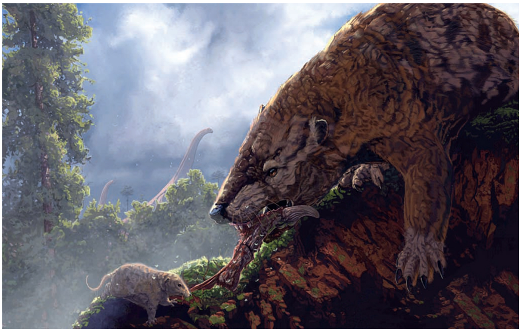
In middle Eocene Germany, the early equid *Propalaeotherium* is in the sights of the planocraniid *Boverisuchus*. These heavily armoured crocodyliformes were long-legged terrestrial hunters that, after the K-Pg extinctions, left the water to fill the predatory niches vacated by theropod dinosaurs.

• Digital | 2021



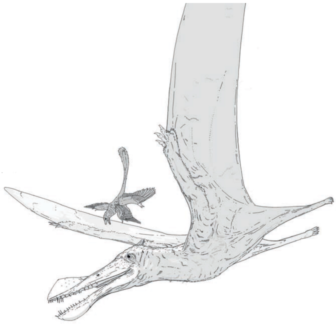
FALLEN *ALBERTOSAURUS*, BABY *CENTROSAURUS*
In a gloomy Late Cretaceous forest clearing, a decaying *Albertosaurus* skeleton being consumed by the forest is considered briefly by a young ceratopsian. Then as now, the enormous skeletons of big animals would have provided nutrients for fungi, scavenging invertebrates, plants and even calcium-hungry herbivorous vertebrates.

• Digital | 2021



GOBICONODON AND SMALL THERIAN MAMMAL
Numerous recent discoveries and studies have overturned several traditional ideas about Mesozoic mammals. One is that the evolution of therian mammals – the group that includes us placentals – was ‘held back’ by the presence of dinosaurs. It now seems that other, more archaic mammal groups were occupying ecological roles that prevented therians from expanding further. Here, a therian is dwarfed by *Gobiconodon*, a predatory mammal of the Jurassic and Early Cretaceous similar in size (and perhaps habits) to the modern Tasmanian Devil.

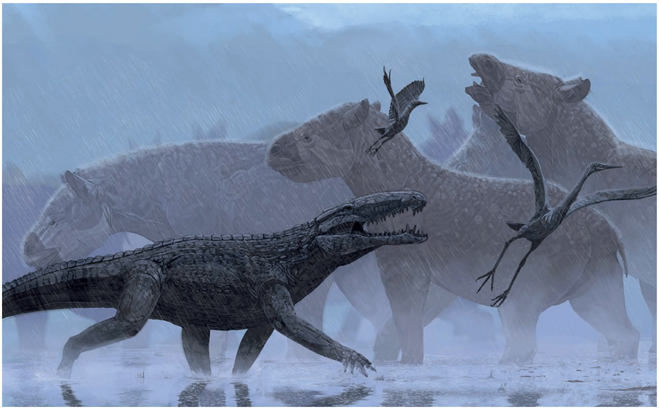
• Digital | 2021



LIAONINGOPTERUS SKETCH

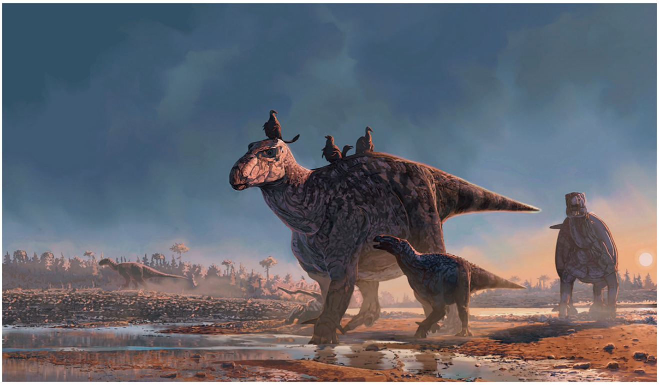
Liaoningopterus is a big Early Cretaceous Chinese pterodactyloid pterosaur with a wingspan of around 5m. It shared its habitat with many other pterosaurs, and theropods like the small dromaeosaurid *Microraptor*. It's unknown whether these two ever came into the close proximity shown here, but the idea is certainly entertaining.

• Digital | 2021



LANGSTONIA AND _HUILATHERIUM_
Miocene South America teemed with an array of amazing animals. Among them are the sebecosuchians, a group of long-legged terrestrial crocodyliforms. *Langstonia* is a sebecid sebecosuchian from Colombia that lived alongside the likes of *Huilatherium* – a large, herbivorous, vaguely tapir-like toxodont with robust limbs and tusk-like incisor teeth.

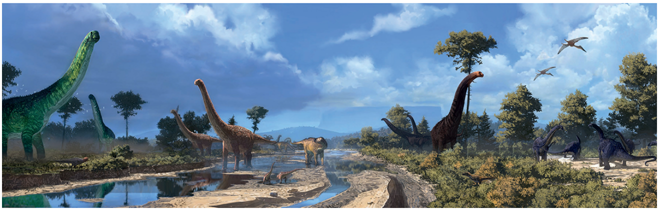
- **Digital | 2021**



IGUANODONTS AT SUNSET

The idea that all the big iguanodontian dinosaurs of Early Cretaceous Western Europe should be shoe-horned into *Iguanodon* began to properly come apart in 2010 with the naming of the big, robust *Barilium* and the smaller, more lightly built *Hypselospinus* (shown in the background). Both are from an older part of the southern English Wealden formation than *Iguanodon* proper. Small maniraptoran theropods sit atop the big iguanodontians in the same way an egret might ride an elephant or rhino.

• Digital | 2021



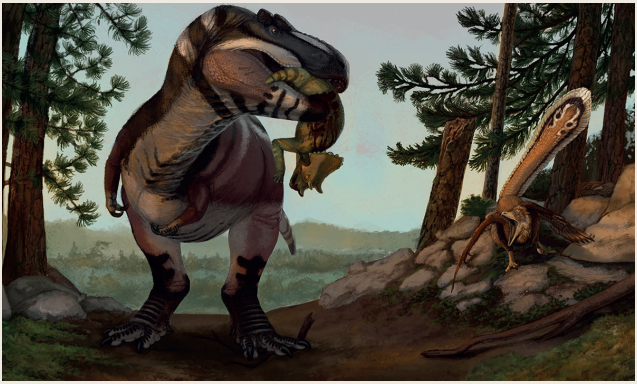
SAUROPODS OF ARGENTINA

This sweeping environmental scene depicts some of the exceptional diversity recorded among the sauropods of Argentina, a region that might be regarded as the sauropod capital of the world. From left to right, we see the stupendous titanosaur *Argentinosaurus* and its 'mid-sized' relative *Andesaurus*, the rebbachisaurid *Limaysaurus* (with the relatively short neck), the chunky titanosaur *Dreadnoughtus* and the 'small', armour-plated *Saltasaurus*. Some non-sauropods populate the scene as well, including a pair of the abelisaurid *Skorpiovenator* and an elasmarian ornithopod. Azhdarchoid pterosaurs fly overhead.

- **Digital | 2021**

USA

STEPHANIE DZIEZYK

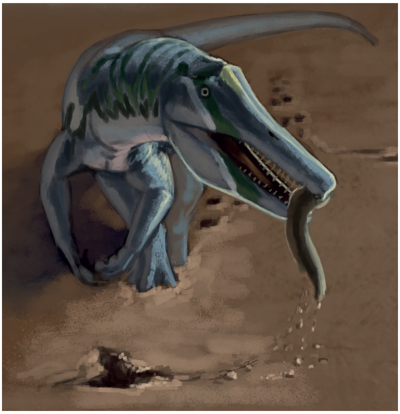


DISTURBING THE NEIGHBOURS

In this Late Cretaceous scene, a nesting *Dakotaraptor* pair (the female partially concealed in the trees) objects to the presence of a *T. rex*, passing by with its juvenile *Triceratops* prey, intended for her own hatchlings. Cryptic colour schemes dominated by browns, as well as prominent barring and striping, are logical for animals adapted for life in the densely forested habitats of western North America.

- **Digital | 2021**

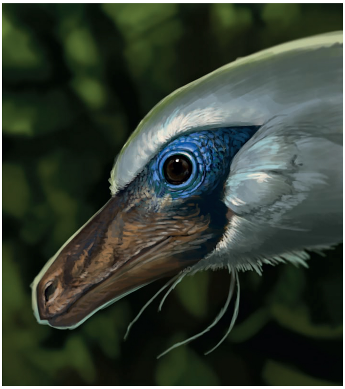
STEPHANIE IS FROM Swan's Island, Maine, where she engendered a love for natural history and art. She graduated from the University of Maine, Orono, with a Bachelor of Arts in Studio Art, and a Minor in Zoology. She is currently a full-time freelance artist and owner of Tricaudae Studio, where she specialises in depicting creatures living, extinct and fantastic. She also produces scientific illustrations, including surgical plates for St Thomas Medical Group in Nashville, Tennessee. Stephanie uses a broad range of media – from oils and acrylics to digital 3D sculpting – but her favourite remains graphite pencilling. She currently resides in Ontario, Canada.



ON THE MUDFLATS

This Early Cretaceous Brazilian spinosaurid *Irritator challengeri* has successfully extracted a lungfish from its aestivation burrow. *Irritator* is only definitively known from its beautifully preserved skull, though other Brazilian remains may also belong to it. They suggest that it lacked the tall dorsal sail present in related spinosaurids and, at an estimated 8m in length, was one of the smallest. The lungfish is a neoceratodontid, the group that persists today in the form of the Australian lungfish *Neoceratodus*.

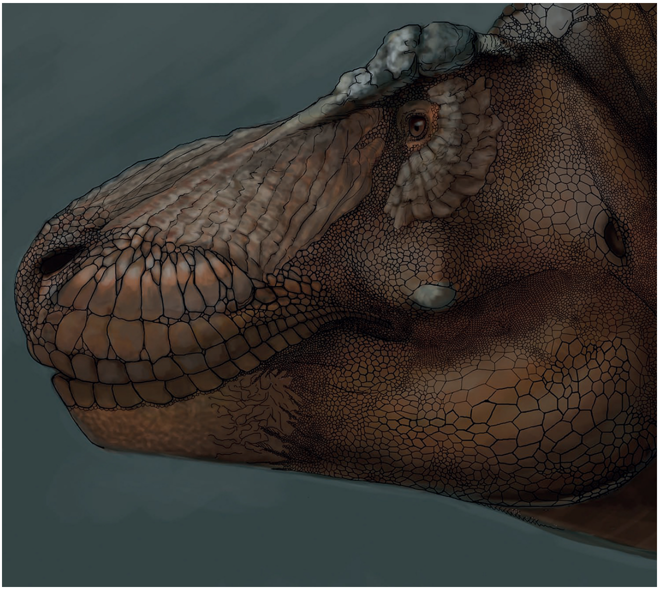
• Digital | 2015



HESPERONYCHUS ELIZABETHAE

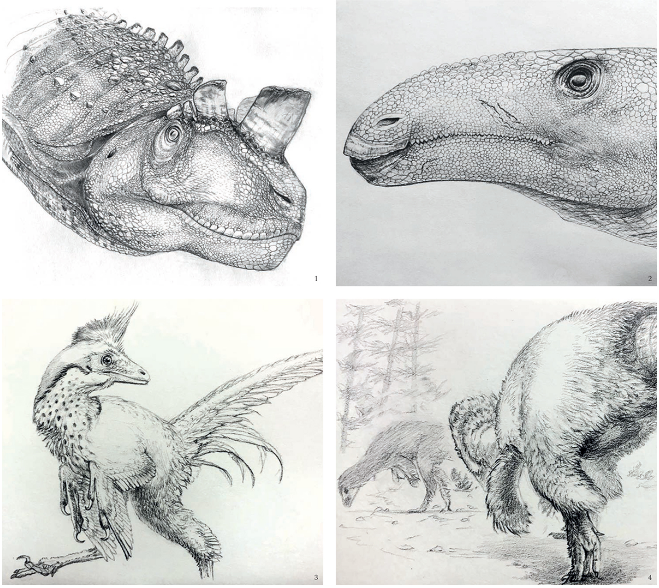
Speculative portrait of *Hesperonychus elizabethae*, a Late Cretaceous dromaeosaurid from Canada, described in 2009 from a pelvic girdle. Less than 1m long, this small dinosaur appears to be a microraptorine – the same group as *Microraptor*, famous for its large hindlimb feathers. It remains unknown whether *Hesperonychus* possessed a similar configuration. The plumage here is inspired by the Bali Myna, a critically endangered member of the starling family.

• Digital | 2018



TYRANNOSAURUS REX SOFT TISSUE STUDY
Perhaps more proverbial ink has been spilt on the topic of *T. rex*'s facial anatomy than any other subject in the realm of palaeoart. The lines of evidence considered in building this image include the extent of the thick, horn-like texturing, the presence of big, plate-like scales on the face and the form and extent of the lips, all hotly debated issues in recent years.

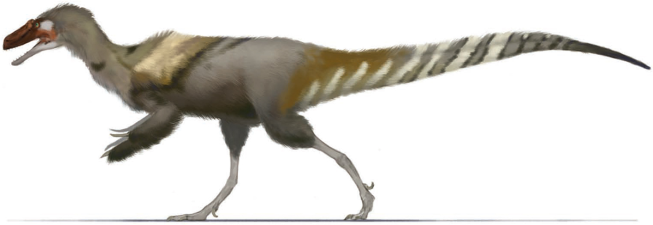
• Digital | 2021



GRAPHITE DRAWINGS AND STUDIES

1) The Late Jurassic theropod *Ceratosaurus nasicornis*; 2) the Early Cretaceous iguanodontian *Mantellisaurus atherfieldensis*; 3) the Early Cretaceous maniraptoran theropod *Sinovenator changii*; and 4) the Late Cretaceous bipedal ornithischian *Parksosaurus warreni*. Stephanie admits a fondness for pencil and paper, and especially likes mechanical pencils due to their precision.

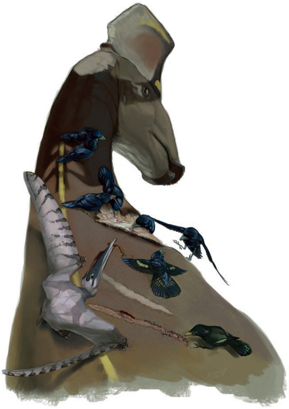
- **Pencil | 2018–2020**



TANYCOLAGREUS TOPWILSONI

This illustration of the Late Jurassic North American theropod *Tanycolagreus* is mostly an experiment in the implementation of integument and patterns. Based on our knowledge of other coelurosaurs, feathering like that shown here is distinctly possible. *Tanycolagreus* (named in 2005) is thought to be an archaic member of Coelurosauria, perhaps a member of Tyrannosauroidea.

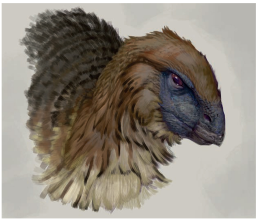
- **Digital | 2019**



GOURMAND'S DELIGHT

Based on our knowledge of living animals, it's possible that small Mesozoic vertebrates might have fed on the tissues of their giant contemporaries. In this speculative scene, a pterosaur is preventing an injury from healing on a *Blasisaurus canudoi* – a Late Cretaceous Spanish lambeosaurine hadrosaur – while an enantiornithine bird is eating larvae infesting the wounds. Another necrotised injury has attracted enantiornithines of a different species.

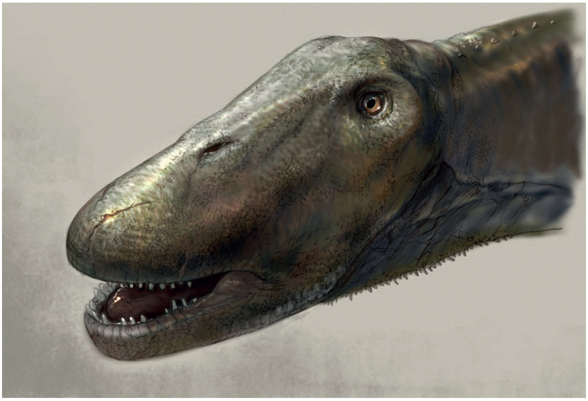
• Digital | 2018



A COLD DAY

The discovery of hair-like filaments and other elaborate, non-scaly structures in small ornithischians suggests these animals might have looked superficially theropod-like, or even bird-like. Stephanie's idea for this piece is that this *Hypsilophodon foxii* may be hiding an incubating illness under its feathers, the evidence for which might not be visibly obvious until too late. *Hypsilophodon* is a well-known Early Cretaceous ornithischian from Western Europe, conventionally regarded as an ornithopod.

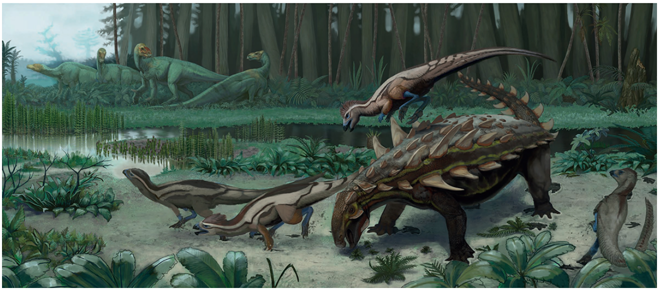
• Digital | 2020



ALAMOSAURUS STUDY

A portrait of the Late Cretaceous North American titanosaur *Alamosaurus sanjuanensis*. The skull anatomy of *Alamosaurus* is currently unknown (only isolated teeth have been reported), so inferences were taken from similar titanosaurs.

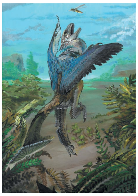
- **Digital | 2018**



A CHASE – THE WESSEX FORMATION

This Early Cretaceous Western European scene suggests hypothetical interactions between various contemporaneous dinosaurs. It shows a group of *Hypsilophodon foxii* disturbing a peacefully foraging *Polacanthus foxii*. A male *Hypsilophodon* gives chase to a competitor, spooking the females in the process. A group of *Iguanodon bernissartensis* view events from a distance.

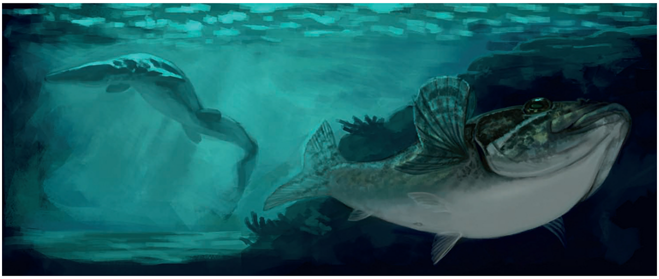
- **Digital | 2022**



JUMP, *BAMBIRAPTOR*, JUMP!

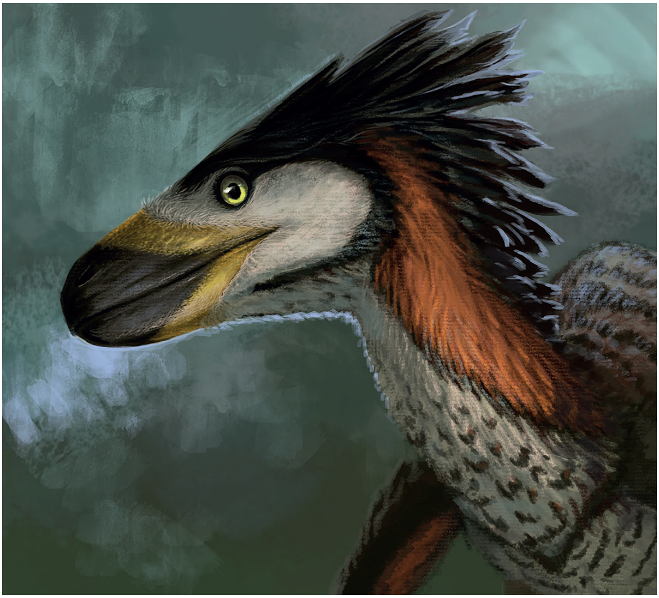
The Late Cretaceous *Bambiraptor feinbergi* – a dromaeosaurid from Montana, named in 2000 – leaps at a wasp-like insect. Phylogenetic placement of *Bambiraptor* is uncertain but recent studies find it closely allied to *Saurornitholestes*. It's even been suggested that *Bambiraptor* might be a juvenile of that animal. Several features are consistent with the agility depicted here, including the well-developed cerebellum, the wishbone and accompanying chest bones, and the long arms and hands and their associated feathers, termed remiges.

- **Acrylic on board | 2018**



GOING UNNOTICED
A small Late Cretaceous Italian teleost *Sorbinicharax verraesi* successfully avoids *Eonatator sternbergii*, a geographically widespread mosasaur less than 3m long (and therefore small relative to other group members). *Eonatator* is a halisaurine, a group thought to be anatomically archaic compared to most other mosasaur lineages. Placement of *Sorbinicharax* in the vast teleost fish radiation remains uncertain. Its broad body and upturned mouth suggest a bottom-dwelling lifestyle.

• Digital | 2021



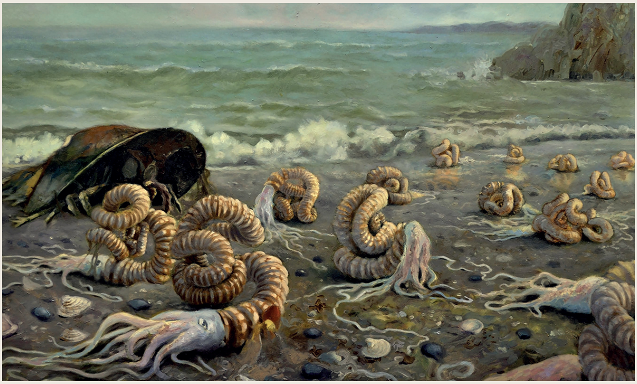
SHROUDED

The early 1990s discovery of a giant, heavily-built dromaeosaurid – heavier than a polar bear and perhaps 7m in length – was quite the sensation. *Utahraptor*, named in 1992, is from the Lower Cretaceous Cedar Mountain Formation. *Utahraptor* was described from fragmentary remains, but numerous additional finds – representing several different growth stages – means it is now well understood. The look of the animal here is inspired by that of the Ornate Hawk-eagle.

• Digital | 2021

ITALY

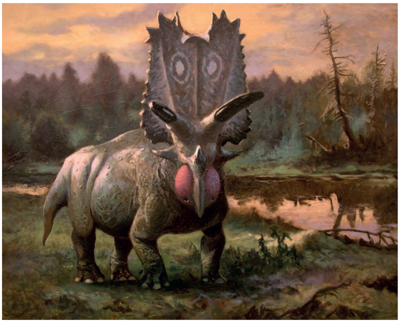
EMILIANO TROCO



BEACHED *NIPPONITES MIRABILIS*
Ammonites repeatedly evolved 'uncoiled' forms of variable shape, termed heteromorphs. How heteromorphs lived is the subject of disagreement. They might have been passive drifters or lived close to the seafloor, perhaps anchoring themselves onto sponges and other objects. *Nipponites* is a Late Cretaceous heteromorph from Japan. Here the horseshoe crab *Crenatolimulus* scavenges the aftermath of a spawning event.

- **Oil on canvas | 2013–2014**

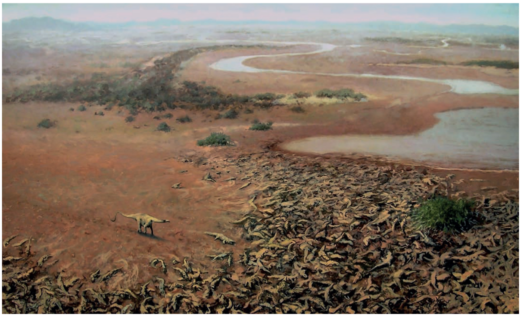
FOLLOWING STUDIES IN PAINTING at the Academy of Fine Art in Venice, Emiliano chose to devote himself to palaeoart. He currently manages his own atelier (an artist's studio), open to the public. As well as providing a space to exhibit his work and a workshop where people can watch him painting, Emiliano's atelier is also used as a forum to explain the relationship between science and art. He has also worked with palaeontologists on numerous projects required for museums and universities. His principal medium is oils on canvas or wood.



PENTACERATOPS AT DUSK

This painting of the great long-frilled ceratopsian *Pentaceratops* captures the idea that some palaeoart can truly be ‘high art’. The image also encapsulates the proposal that the unusual and massively developed nostril openings of these dinosaurs could be inflated in display.

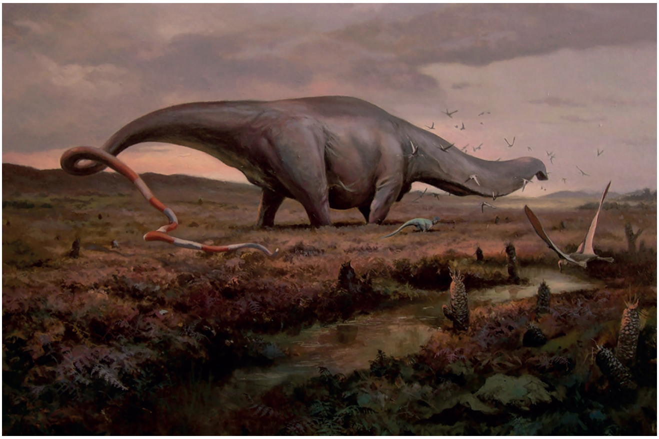
- **Oil on canvas | 2018–2020**



TATAOUINEA

The rebbachisaurid sauropod *Tataouinea* on an Early Cretaceous Moroccan floodplain. *Tataouinea* is known from the tail, sacrum and pelvis, and was around 13m long, with a neck of moderate length. It is named for Tataouine, the discovery site of which might sound familiar to space-opera fans. Crocodyliforms of several species scramble clear of the sauropod.

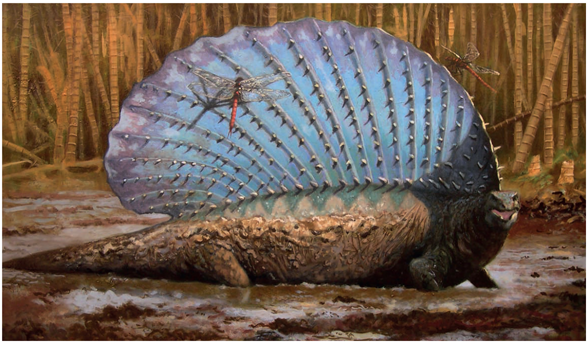
- **Oil on canvas | 2012–2013**



THE BIG *LOUISAE*

The great diplodocid sauropod *Apatosaurus louisae* on a Late Jurassic moorland dominated by dense ground-hugging plants. This reconstruction provocatively implies an unusual neck anatomy, with thick, paired ridges along the neck's underside. The patterning of the whip-like section of the tail also suggests an interesting function. Pterodactyloid pterosaurs and ornithopod dinosaurs trail the sauropod.

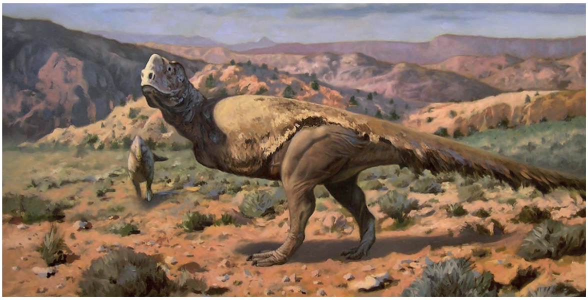
• Oil on canvas | 2017–2019



EDAPHOSAURUS* AND *MEGANEUROPSIS

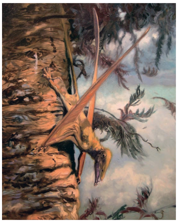
Animals of the past surely lounged in mud and took baths, just as so many animals do today. The use of bright colours on the edaphosaur's sail suggests that it was a display structure, not a specialised 'thermal' organ as proposed in the past. Several *Edaphosaurus* species are known. This is *E. criciger*, a large edaphosaur from the Early Permian of the United States. *Meganeuropsis* and its kin – often misnamed 'giant dragonflies' – actually belong to a distinct group: the Megasinoptera or griffinflies.

• Oil on canvas | 2017–2019



ABELISAURIDS
The Cretaceous abelisaurids are among the strangest and most fascinating of theropods. Key traits include deep snouts and arms so small as to be hard to spot – they might even have been concealed. Most evidence suggests a scaly covering in these dinosaurs, but a partial filamentous covering is an exciting speculation.

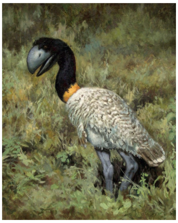
• Oil on canvas | 2014–2017



ARBOREAL *EUDIMORPHODON*

In a piece reminiscent of a Zdeněk Burian painting, the small Late Triassic Italian pterosaur *Eudimorphodon* is shown in an arboreal setting. Claws and digits built for gripping, flexible limbs and small size suggest that many early pterosaurs were capable clingers and climbers.

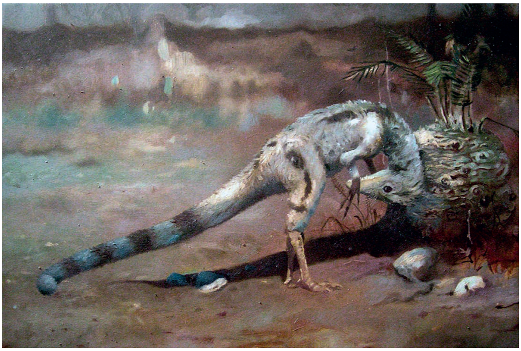
• Oil on canvas | 2013–2017



GASTORNIS

The famed ‘horse-eating bird’ of the North American and European Paleogene – *Gastornis* – was probably not a predator, but a herbivore or omnivore. The ‘traditional’ idea of a shaggy, cassowary-like plumage no longer seems correct. *Gastornis* was seemingly related to wildfowl, so perhaps might have vaguely resembled a giant goose.

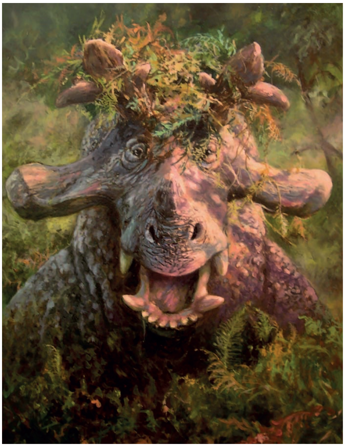
- **Oil on canvas | 2017–2019**



SCIPIONYX SAMNITICUS

Italy's most famous dinosaur – *Scipionyx*, from the Early Cretaceous – is known from an exquisite, near-complete skeleton less than 25cm long. It preserved muscle tissue, the guts, and parts of the stomach and trachea. *Scipionyx* is clearly a juvenile; recent work suggests it might be the young of a giant theropod.

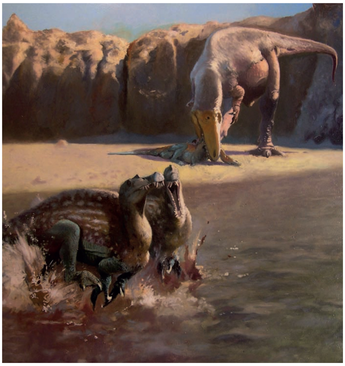
• Oil on canvas | 2011



PEEK-A-BOO!

Despite being named in 1960, *Estemmenosuchus* – a large dinocephalian synapsid from the Middle Permian of Russia – rarely made an appearance in global palaeoart until the 1990s. Two species are known: this is the more elaborate *E. mirabilis*. At 3m long, it is big for a stem-mammal. How these animals used their amazing headgear remains, as ever, an interesting question. The *implication* here is that these were 'antlers' used by the animals in display, and maybe even increased in size and shock value by vegetative decoration.

• Oil on canvas | 2017–2019



SAUROINIOPS

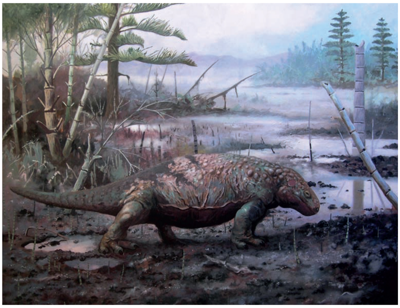
‘Middle’ Cretaceous North Africa features a surprising and awesome diversity of big theropods, including *Sauroniops* (background), a giant carcharodontosaurid named in 2012 and – so far – known only from part of its thickened skull roof. In the water – perhaps playing – are two juvenile spinosaurines. Adaptations to aquatic life include webbed feet, but they lack the large dorsal sail characteristic of adults.

- **Oil on canvas | 2012–2013**

ARTHROPLEURA

Known from throughout the Carboniferous and surviving into the Permian, *Arthropleura* is a millipede known from several species, the largest of which – *A. armata* – reached a gigantic 2.5m in length. *Arthropleura* fossils seem to consist solely of moulted skin-casts or exuviae, rather than remains of the animal itself. It is thought to be herbivorous like modern millipedes, but the assumption it was a forest inhabitant has been challenged by trackways attributed to the animal in more open environments. Larval forms can be seen top right.

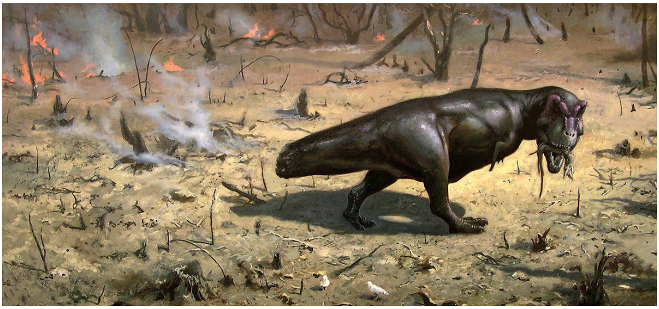
• Oil on canvas | 2014



BROMACKER'S BOGS

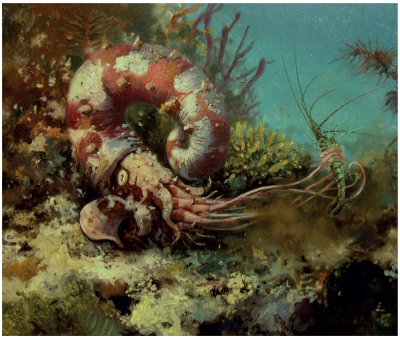
Located in central Germany, the prolifically fossiliferous locality of Bromacker is part of the Tambach geological formation dating from the Lower Permian. Studies indicate an arid upland or mountainous habitat whose flora is dominated by hardy, drought-resistant plants. A lack of permanent lakes and rivers means that the large amphibians usually common in the Permian are not present; the landscape is instead home to tough reptiles, and tetrapods such as the *Diadectes* shown here, in a bog surrounded by various species of the horsetail *Calamites*.

- **Oil on canvas | 2021**



‘WYREX’
Emiliano based this *Tyrannosaurus*, which has located a meal at the edge of a forest fire, on ‘Wyrex’, a *T. rex* fossil found in Montana in 2004. The animal was missing a large portion of its tail; how long it survived following the injury is unknown, although there seems to be little sign of healing around the wound. Small skin impressions were also found on ‘Wyrex’. Made up of pebble-shaped scales, the largest of which was 4cm across, these impressions suggest that at least some areas on *T. rex* were unfeathered.

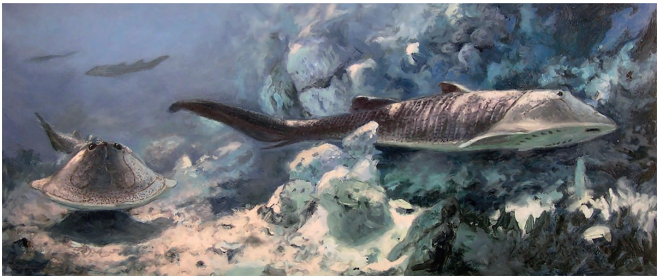
• Oil on canvas | 2021



SCAPHITES

Scaphites is another Late Cretaceous heteromorph ammonite, whose ‘uncoiling’ is more subtle than that of other heteromorphs. Ammonites were around for more than 300 million years and no doubt evolved a tremendous variety of soft tissue features, habits, and feeding and breeding adaptations. The function of the tubercles visible here remains speculative.

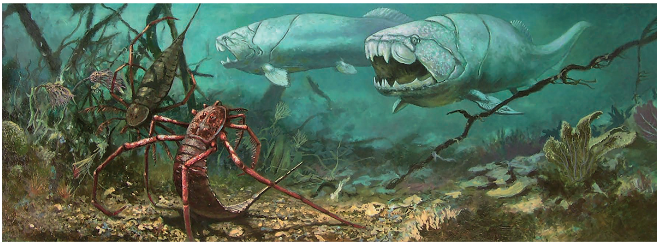
- **Oil on canvas | 2012**



ATELEASPIS

Ateleaspis is a 15–20cm-long member of Osteostraci, a class of ancient armoured fish belonging to Agnatha or jawless fish, modern representatives of which include lampreys and hagfish. Known from Scotland, Norway and Russia, *Ateleaspis* lived from the Early Silurian to the Early Devonian. Its head shield is a common feature of osteostracans; it is also thought to be the earliest-known vertebrate with paired fins.

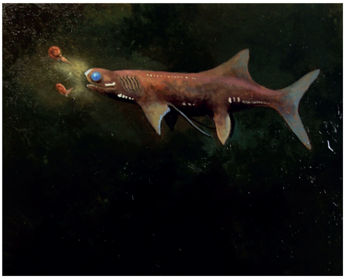
• Oil on canvas | 2021



DUNKLEOSTEUS VS *STYLONURUS*

Having caught the eye of the armoured placoderm *Dunkleosteus*, the eurypterid *Stylonurus* threatens the fish with its stinger-like telson. Due to their superficial resemblance to scorpions, and because they inhabited marine and aquatic environments, eurypterids are often called 'sea scorpions', but they are only distantly related to their terrestrial namesakes. In this picture, *Stylonurus* uses a more ant-like posture to employ its telson. Known from the Devonian of Germany, Scotland and the United States, *Stylonurus* has spines on those appendages closest to its head that may have acted as rakes to comb the seabed for food.

- **Oil on canvas | 2021**



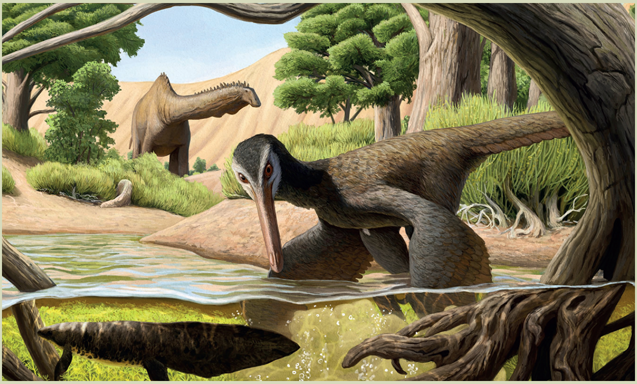
CARBONIFEROUS BIOLUMINESCENCE

This speculative image pits the archaic cartilaginous fish *Cobelodus* against two small ammonites. As an anti-predator adaptation, the ammonites are emitting a bioluminescent cloud like that expelled by certain deep-sea cephalopods today. *Cobelodus* itself is shown as possessing light-emitting organs. Bioluminescence has evolved on more than 40 known occasions in living animals and it was very probably present in numerous extinct groups.

• Oil on canvas | 2019–2021

ARGENTINA

LUCAS ATTWELL

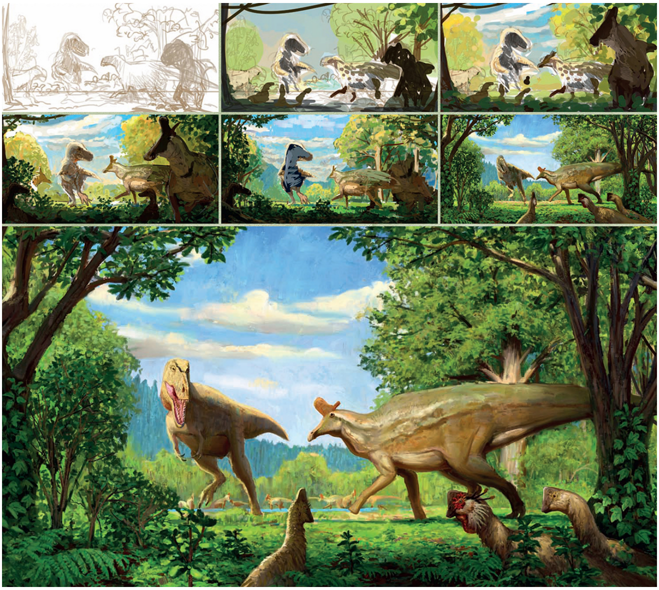


BUITRERAPTOR IN THE KOKORKOM DESERT
These long-faced, possibly amphibious unenlagiine dromaeosaurids have proved popular subjects among modern palaeoartists. This scene – depicting animals and plants known from the Upper Cretaceous Candeleros formation of Argentina – shows the *Buitreraptor* eyeing a lungfish. A rebbachisaurid sauropod looms in the background. Lucas has used the time-honoured technique of giving us both an above- and below-water perspective.

- **Digital | 2021**

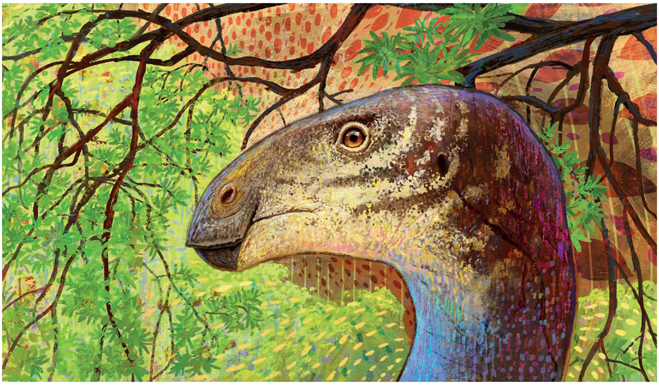
HAILING FROM ARGENTINA, Lucas began drawing dinosaurs at the age of three, but first considered becoming a palaeoartist after seeing the work of Emily Willoughby in 2014. He began studying animal anatomy and the skeletal and muscle reconstructions of palaeoartists Scott Hartman and

Gregory Paul. Lucas's childhood familiarity with the work of artists such as John Sibbick was expanded through the internet, where he was introduced to, amongst others, Douglas Henderson, John Conway and Andrey Atuchin. Lucas uses a lush colour palette and diverse styles, ranging from painterly, almost impressionistic artwork to a more photorealistic approach.



DINOSAUR PARK FORMATION
It's fascinating to see how an artist goes from initial sketch to coloured prototype to final form, and digital art makes it easier than ever for artists to record these steps. This series shows Dinosaur Park Formation dinosaurs: the tyrannosaurid *Gorgosaurus* (left) and the hadrosaur *Lambeosaurus*. It is interesting to see how the final version ended up presenting the hadrosaur as the aggressor! Caenagnathids – showing apparent sexual dimorphism – are in the foreground.

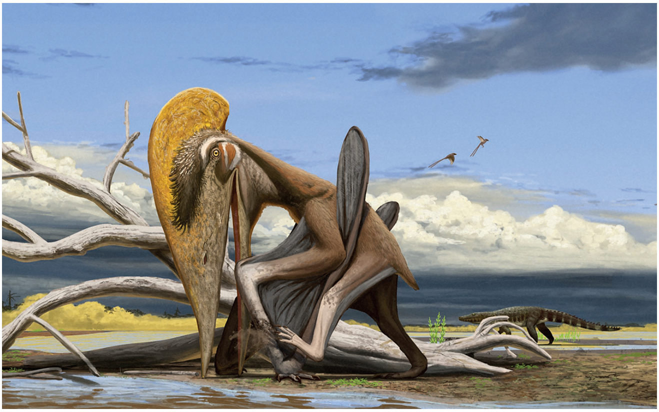
• Digital | 2021



CAMPTOSAURUS DISPAR

Dinosaurs traditionally shown in ‘old school’ palaeoart were almost mocked or caricatured by those depicting them. However, stalwarts such as the Late Jurassic ornithopod *Camptosaurus* were probably elegant and even beautiful, as suggested here, against a fantastic verdant floral setting. But are the spots and stripes in the background abstract and random whimsy, or perhaps a reminder that *Camptosaurus* shared its world with animals whose bodies were so large that only difficult-to-interpret sections might have been visible at any one time?

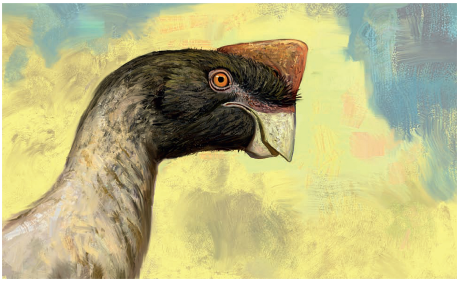
- **Digital | 2021**



TUPUXUARA

It is mostly agreed today that azhdarchoid pterosaurs like Brazil's *Tupuxuara* were terrestrial foragers, probably with good walking abilities. (Azhdarchoidea is a larger group that includes the azhdarchids, tapejarids, thalassodromids, chaoyangopterids and others.) This reconstruction does not depict the best-known species of *Tupuxuara* (*T. longicristatus*), but the lesser-known *T. deliradamus*, named in 2009 and noted for its more diamond-shaped nasoantorbital fenestra (the big opening on the side of the snout). In the background are the terrestrial notosuchian croc *Araripesuchus gomesii* and enantiornithine birds.

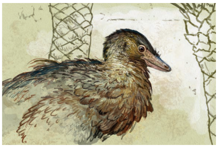
• Digital | 2019



NEMEGTOMAIA BARSBOLDI

Portrait of the mid-sized Late Cretaceous Mongolian oviraptorid *Nemegtomaia*. The unambiguous feathery covering of smaller, older oviraptorosaurs like *Caudipteryx* demonstrate that all members of this group were feathered. However, no fossil has yet been good enough to demonstrate the *exact* distribution of soft structures across the face, although these animals were certainly bird-like.

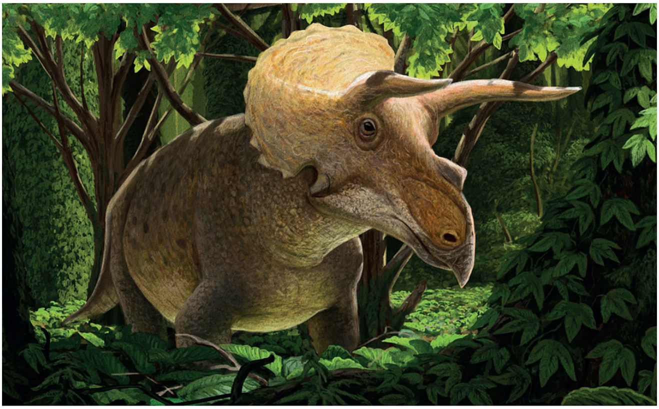
• Digital | 2021



XIAOTINGIA SKETCH

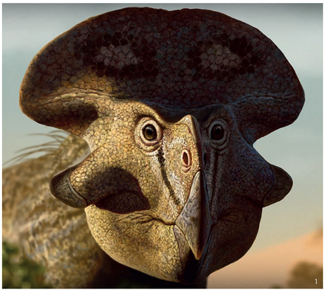
Xiaotingia is a small Late Jurassic Chinese maniraptoran, named in 2011. Lucas's more sketchy style here emphasises that the plumage of these little dinosaurs was probably highly mobile and could 'fluff up' as and when it was appropriate.

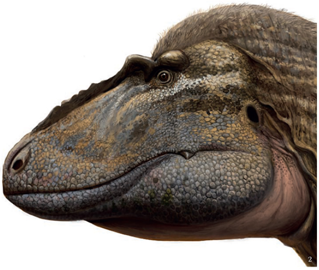
- **Digital | 2021**

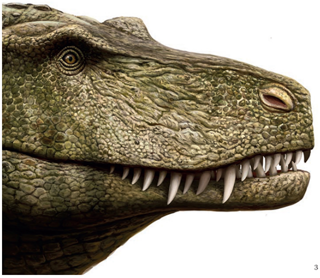


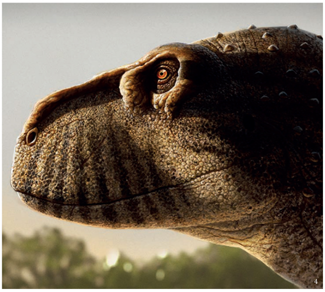
TRICERATOPS
Triceratops – one of the last and largest of the horned ceratopsians – remains a firm favourite among artists and art-viewers alike. We know a vast amount about its life appearance, much of which is reflected here (note the variation in scale form across the neck and body). Nevertheless, uncertainty remains about such details as its facial covering. Additionally, species and individuals within the genus are phenomenally variable, meaning that there is much scope for experimentation and diversity in its appearance.

• Digital | 2021



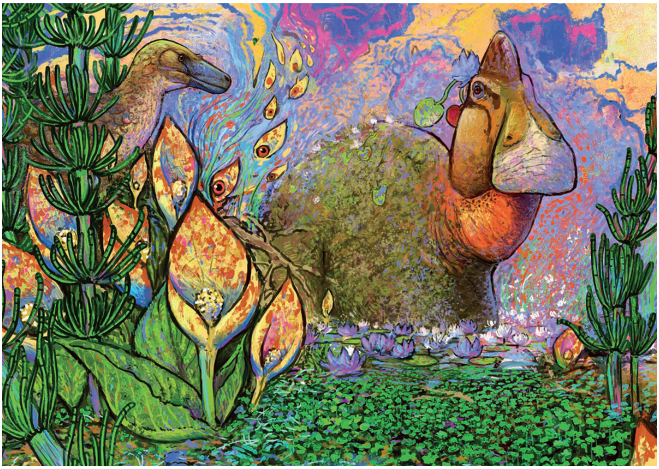






1) *PROTOCERATOPS*, Digital | 2021
2) *LYTHRONAX*, Digital | 2019
3) *SAUROSUCHUS*, Digital | 2021
4) *SKORPIOVENATOR*, Digital | 2021

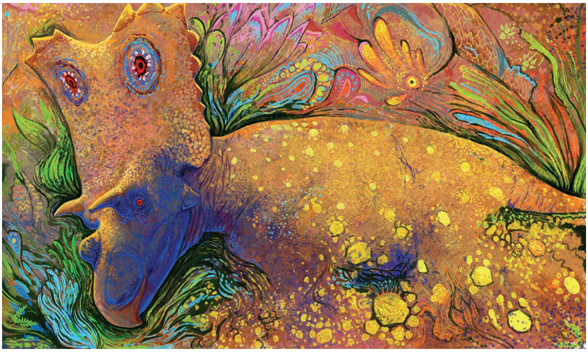
Dinosaurs and other archosaurs (like the Triassic rauisuchian *Saurosuchus* shown bottom left) have charismatic, striking faces – most probably part of their appeal! These portraits demonstrate Lucas's attention to such details as texture, topography and technical variation in tissue type. The facial features of some of these animals – seen most prominently here in *Protoceratops* and the abelisaurid *Skorpiovenator* – also cast sharp, deep shadows in certain lights.



HYPACROSAURUS AND *ATROCIRAPTOR*

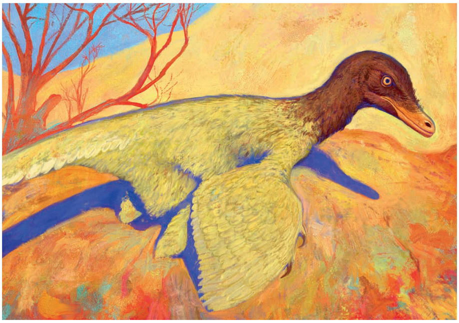
An experimental, slightly abstract piece that highlights the prominent facial features of the giant lambeosaurine hadrosaur *Hypacrosaurus*, a vivid skyscape and varied looming plants. Again, this is suggestive of the form, texture and colour that co-exists between plants and animals so often in nature. The Canadian dromaeosaur *Atrociraptor* enters stage left. The flowering plant is an extinct relative of skunk cabbages.

• Digital | 2021



PSYCHEDELIC *CHASMOSAURUS*
A stylised piece depicting the ceratopsid *Chasmosaurus*. Dinosaurs were probably vivid, sometimes richly textured and boldly marked, so it's compelling to depict these features in an abstract form. This piece also has shades of artists such as Gustav Klimt and Claude Monet. The scalation patterns of the chasmosaur are repeated outside the animal's margins, suggestive of its link with the wider world it inhabits.

- **Digital | 2019**



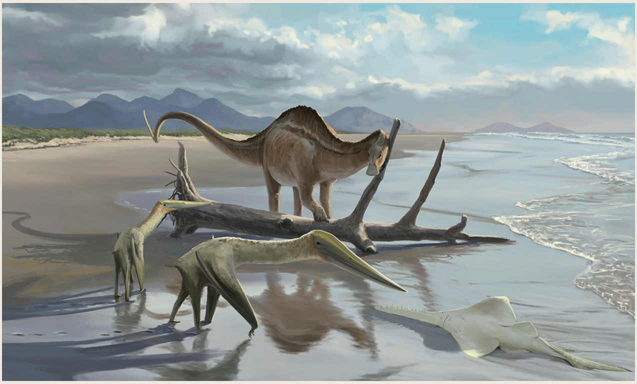
IMPRESSIONISTIC *VELOCIRAPTOR*

The Late Cretaceous Mongolian dromaeosaurid *Velociraptor mongoliensis* is depicted crouching in a desert setting, another reminder that even accurate dinosaurs can be portrayed in art that extends beyond the photorealistic style conventional for palaeoart. The palette alone creates a sense of desert heat. Many possibilities exist for the appearance of this fox- or coyote-sized desert-dweller, perhaps resembling modern desert-living animals of similar size in pattern and hue.

- **Digital | 2021**

BRAZIL

JÚLIA D'OLIVEIRA

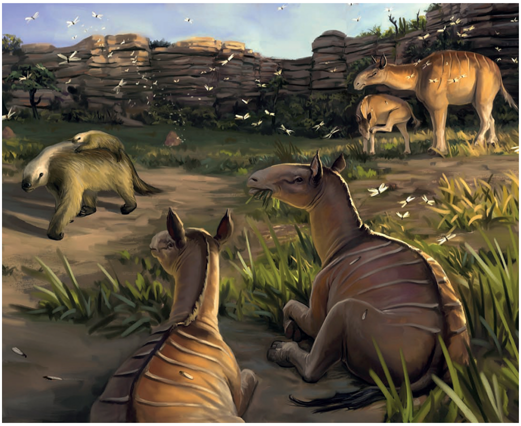


AT THE BEACH

In a scene inspired by the animals and environments of Morocco's famous Kem Kem Group, a rebbachisaurid sauropod and two azhdarchid pterosaurs consider one another while exploring the water's edge. Both groups were present throughout northern Africa during the Late Cretaceous. One of the pterosaurs investigates the beached corpse of an *Onchopristis numidus*, a sawfish-like relative of the skates.

- **Digital | 2020**

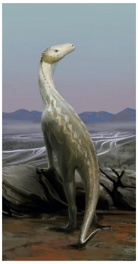
BOTH BIOLOGIST and palaeoartist, Júlia took up palaeoart first as a hobby, painting pterosaurs in acrylics and oils as a way of developing her painting techniques. Keeping pace with palaeontological research, she continues to refine her reconstructions and has begun to provide art for academic papers. Now producing both traditional and digital art, she prefers more peaceful compositions, with particular attention being paid to light and colour.



TERMITE FLIGHT

On an afternoon during the Pleistocene, various Brazilian mammals are surrounded by termite kings and queens taking their nuptial flights. On the right are several *Xenorhinotherium bahiensis*, a litoptern closely related to the more familiar *Macrauchenia*. At more than 3m long and nearly 2m tall at the shoulder, *Xenorhinotherium* was a giant, at least as large, if not larger than, *Macrauchenia*. On the left are a mother and juvenile *Nothrotherium*, a mid-sized ground sloth.

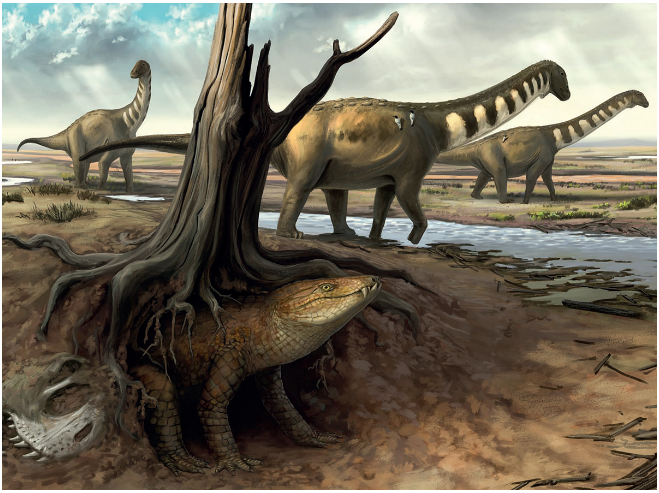
• Digital | 2020



SATURNALIA TUPINIQUIM

Saturnalia of southern Brazil's Santa Maria Formation is one of the world's oldest known dinosaurs, dating to the Carnian Age of the Late Triassic. While superficially theropod-like in appearance, it appears that *Saturnalia* was an early member of Sauropodomorpha, the group that includes the giant sauropods and their relatives. Like all early dinosaurs it was small – less than 1.5m long.

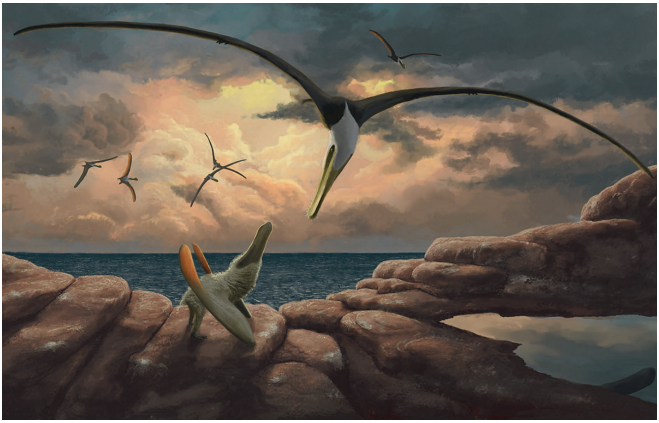
- **Digital | 2020**



AWAKENING

The arrival of rain signals the end of a Late Cretaceous dry season. *Armadillosuchus* – an armour-plated crocodyliform with adaptations for digging – has just awoken from aestivation. Nearby, titanosaurs and some accompanying enantiornithine birds pass by. A skull reveals that a local abelisaurid theropod was not so lucky in surviving the dry season. These animals are known from the Adamantina Formation, a richly fossiliferous geological unit of São Paulo state in south-eastern Brazil.

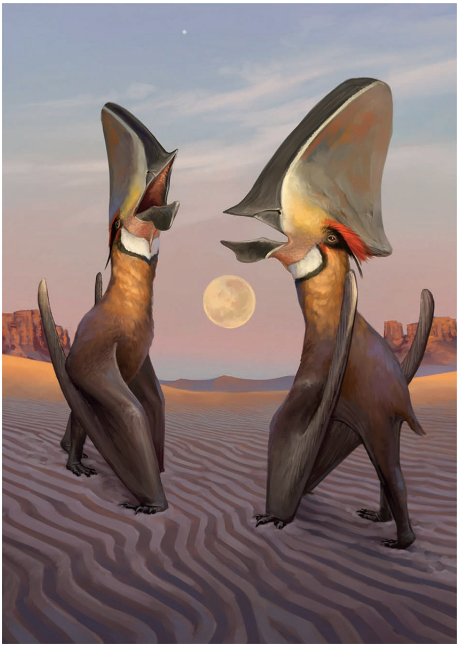
• Digital | 2020



FLAPLING

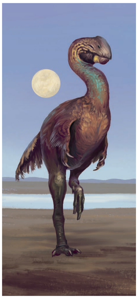
A juvenile of the Cretaceous pterosaur *Anhanguera spielbergi* watches adults fly by from a cliff-top vantage point. This species was originally described as *Coloborhynchus spielbergi*, and was more recently given *another* suggested name, *Maaradactylus spielbergi*. The juvenile's fully formed wings hint at a flight ability – hence the 'flapling' moniker now in widespread use for pterosaur youngsters – but otherwise has a very different appearance from its elders.

- **Digital | 2021**



FULL MOON
Caiuajara dobruskii, from the Late Cretaceous of Brazil, is one of the best known tapejarid pterosaurs thanks to the discovery of numerous specimens preserved packed together in bonebeds from the Paraná Basin in the country's far south. The oddly shaped and often strikingly large head crests of these pterosaurs indicate a role in social and sexual display, as illustrated here.

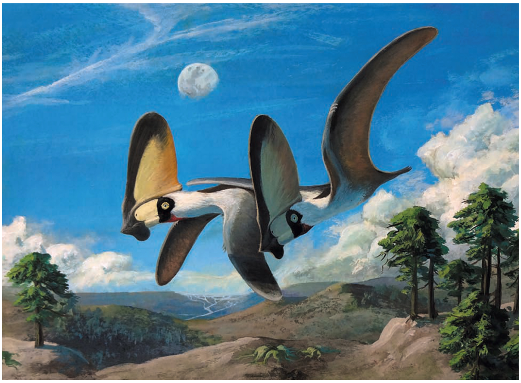
• Digital | 2021



GIGANTORAPTOR ERLIANENSIS

On a Late Cretaceous lakeshore in Inner Mongolia, the gigantic oviraptorosaur *Gigantoraptor* naps beneath a full moon. *Gigantoraptor* is one of the largest maniraptoran theropods known: it was more than 8m long and weighed more than 2 tonnes. Exactly when the avian habit of sleeping on one leg evolved is quite unknown, but it is possible that maniraptorans like oviraptorosaurs practised this habit.

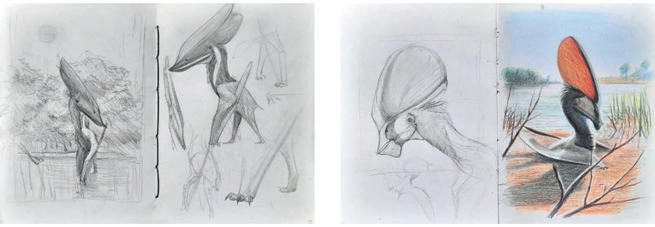
- **Digital | 2020**



WAXING GIBBOUS

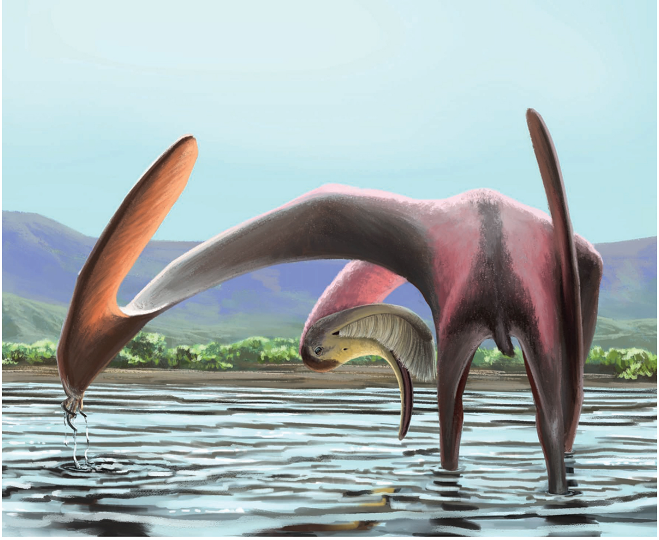
Two *Tupandactylus navigans* fly across a Late Cretaceous landscape destined to form the amazing fossil-bearing Crato beds of eastern Brazil. Plants illustrated in the scene include the gymnosperm *Brachyphyllum obesum* and the gnetophyte *Welwitschiophyllum brasiliense*. Júlia's fondness for amazing skyscapes and the moon is also in evidence.

- **Acrylic on board | 2019**



PREPARATORY SKETCHES FOR LARGE PIECE
Júlia's fondness for azhdarchoid pterosaurs is obvious from this selection of sketches as she works out the form, colour scheme and proportions of various subjects: namely the long-crested *Thalassodromeus sethi* and the shorter-faced *Tupandactylus imperator*. Both are Late Cretaceous azhdarchoids from Brazil.

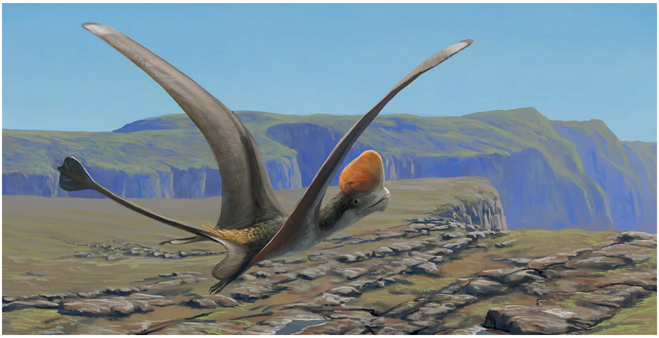
• Graphite and coloured pencils | 2019



TAKING A LOOK

Pterodaustro guinazui is a remarkable filter-feeding pterosaur with curved jaws filled with more than 1,000 bristle-like, tightly packed teeth. It was a wader, with large feet. The animal here might not be grooming – you have to wonder how *Pterodaustro* would actually do this – but it's at least checking out its underside. *Pterodaustro* is unique to Late Cretaceous Argentina and hundreds of individuals are known.

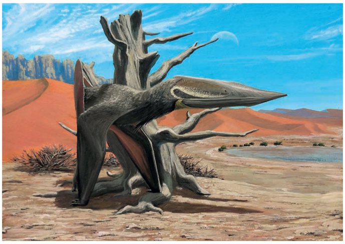
- **Digital | 2020**



CAVIRAMUS SCHESAPLANENSIS

Caviramus is a long-tailed, toothed pterosaur from the Late Triassic of Switzerland, named on the basis of a lower jaw. However, our knowledge of its appearance is mostly based on a partial skeleton described in 2008 as the new genus *Raeticodactylus*. Experts currently disagree on whether the two should be considered synonymous. Regardless, these were fascinating animals, with several different tooth types, a tall skull crest and a keel on the lower jaw.

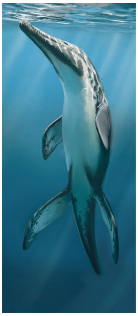
- **Digital | 2020**



WANING CRESCENT

The Brazilian azhdarchoid pterosaur *Keresdrakon vilsoni* stalks the Late Cretaceous Caiuá Desert in search of small terrestrial prey. *Keresdrakon* was described in 2019 as a new member of the azhdarchid family. However, newer studies indicate that it should be allied with the Moroccan *Alanqa* in a group located elsewhere within the azhdarchoid radiation, termed Alanqidae.

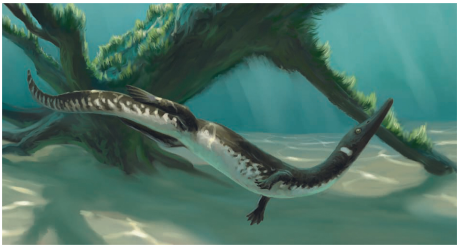
- **Acrylic on board | 2019**



LIOPLEURODON FEROX

The famous Jurassic pliosaurid *Liopleurodon* surfaces to take a breath. Pliosaurs were endothermic, so it *might* be that the regularity of their breathing was about the same as that of similar-sized marine mammals. The big hind-flippers of the animal are especially evident here.

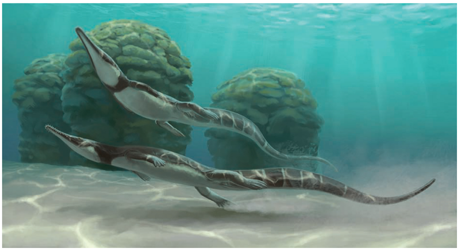
- **Digital | 2020**



BRAZILOSAURUS SANPAULOENSIS

Brazilosaurus is a mesosaur, an unusual group of long-jawed swimming reptiles – or perhaps ‘near reptiles’ – that lived in saline lagoons and inland seas during the Permian around 280 million years ago. Mesosaurs ranged from 30cm to around 1.5m, and *Brazilosaurus* was among the smallest of them.

• Digital | 2020



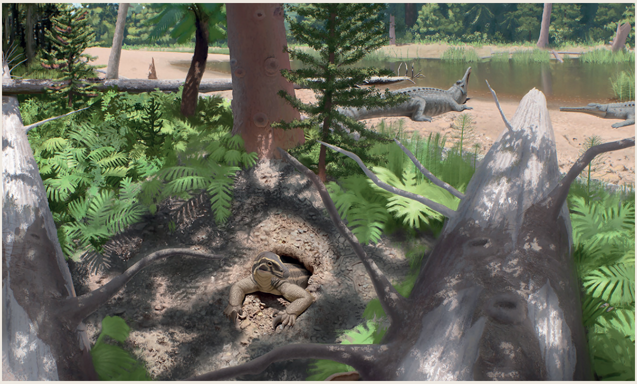
STEREOSTERNUM AND GIANT STROMATOLITES

Another mesosaur: the larger *Stereosternum*, known from both Brazil and South Africa. It reached about 80cm. In the background are giant stromatolites – pillar-like rocky structures built over time by populations of microorganisms. These are known from the same Brazilian fossil site as *Stereosternum*.

- **Digital | 2019**

USA

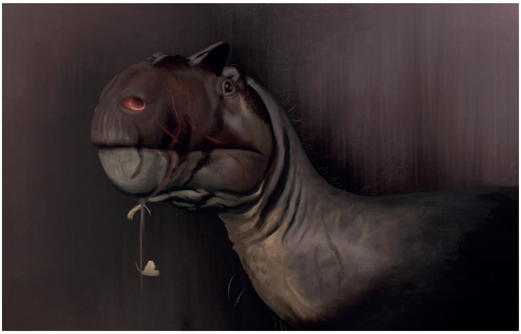
MIDIAOU DIALLO



SKYBALONYX
The Late Triassic of western North America, around 220 million years ago. Emerging from its burrow is *Skybalonyx*, from Arizona. Phytosaurs – a group of superficially crocodile-like near-archosaurs – bask in the background. *Skybalonyx* is a drepanosaur, an unusual group of reptiles that combine a bird-like skull with a vaguely chameleon-like body plan and remarkably odd limbs. Drepanosaurs have been mostly regarded as tree climbers prior to the description of *Skybalonyx*. Midiaou's reconstructions of this animal featured in its official scientific outing in 2020.

- **Digital | 2020**

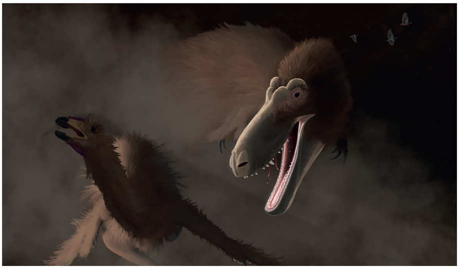
FOR MIDIAOU, the bones towering above him in museums and the raw, fantastical animated creatures he saw on screen were enough to grab his young mind in a vice. All things prehistoric became his key to rationalising the world, and it was through his art that he came to understand that he loved life, human and otherwise. He wanted to share this love with other people, and joined the online palaeoart community around 2013 via DeviantArt, developing relationships with other artists that spanned the globe. With filmmaking and music also being important aspects of his life, the feeling of a piece is always Midiaou's first concern. He also strives to have some lesson etched into each of his illustrations, and to further sell it, he aims, as much as possible, for near photorealism. His goal is to fully immerse the viewer through rendering, composition, lighting, colour and subject matter, thereby nurturing bonds with the natural world. And what better way is there to do that than through something people love: dinosaurs.



ASFALTOVENATOR

The large, Early Jurassic theropod *Asfaltovenator* was named from Argentina in 2019. Drool hangs from its jaw, snaring leaves. Prominent features include lacrimal horns and a smoothly curving upper surface to the deep snout. *Asfaltovenator* appears to be an archaic member of Allosauroidea but possesses various megalosaur-like traits, implying that megalosaurs and allosaurs should be united, a view that has gone in and out of fashion over the decades.

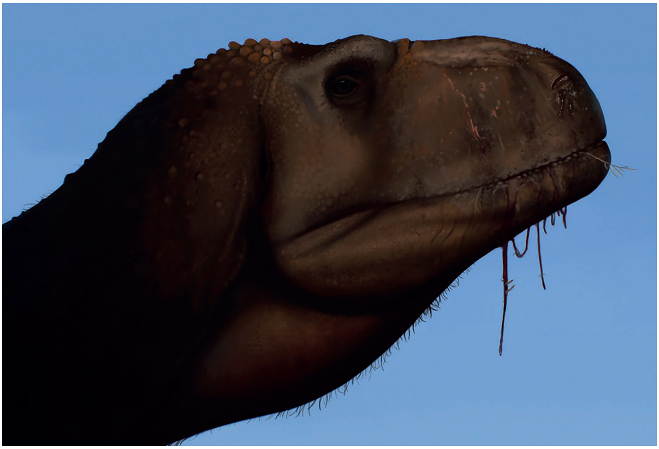
• Digital | 2019



NEAR MISS

On a Late Cretaceous day in eastern Asia, the mid-sized tyrannosauroid *Timurlengia* narrowly misses its prey, the ostrich dinosaur *Archaeornithomimus*. *Timurlengia* was named in 2016. It is so far only known from its braincase, but we can make many informed guesses about its appearance based on tyrannosauroids known from better remains.

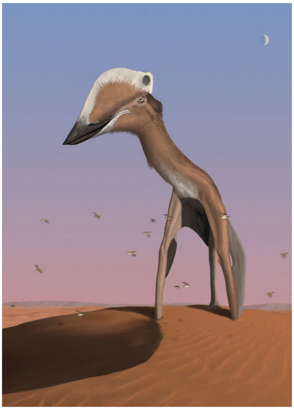
- **Digital | 2017 (Updated 2022)**



VIGILANTE FROM AUCA MAHUEVO

The faces of theropod dinosaurs have proved surprisingly complex, with evidence for a diversity of textures and coverings, and extensive soft structures relating to the jaw edges and nostrils. Here, the Late Cretaceous Argentinian abelisaurid *Aucasaurus garridoi* – a young male – is issuing a low, far-reaching grumble into the early morning air. The various structures on its snout indicate interesting recent events in its life.

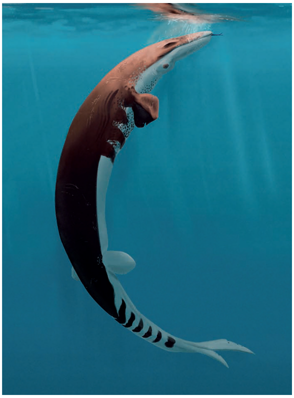
• Digital | 2017 (Updated 2022)



MONGOL GIANT

A large male azhdarchid pterosaur stretches his legs on the sand dunes of Late Cretaceous Mongolia. As yet unnamed, this animal is known from a fragmentary vertebral element that suggests it belonged to one of the largest pterosaurs known. The fossil was also the first pterosaur recovered from Mongolia's famous Nemegt Formation, known for its rich diversity of fossils that includes many dinosaurs.

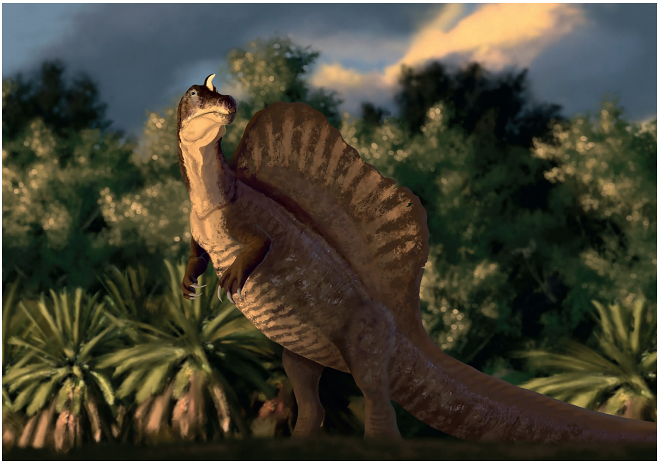
• Digital | 2017 (Updated 2021)



RESURFACE

Today we know that mosasaurs and other Mesozoic marine reptiles were sleek, streamlined animals, often with a near-smooth or microtextured external surface. Possibilities remain wide open for striking and bold colour schemes. Here, a young male individual of the slender-bodied *Clidastes propython* – perhaps 2m long – surfaces for air, and perhaps for cleaning by seabirds or pterosaurs. If mosasaurs are related to snakes or to monitors and kin (both possibilities are viable), they would probably have possessed a forked tongue, as shown here.

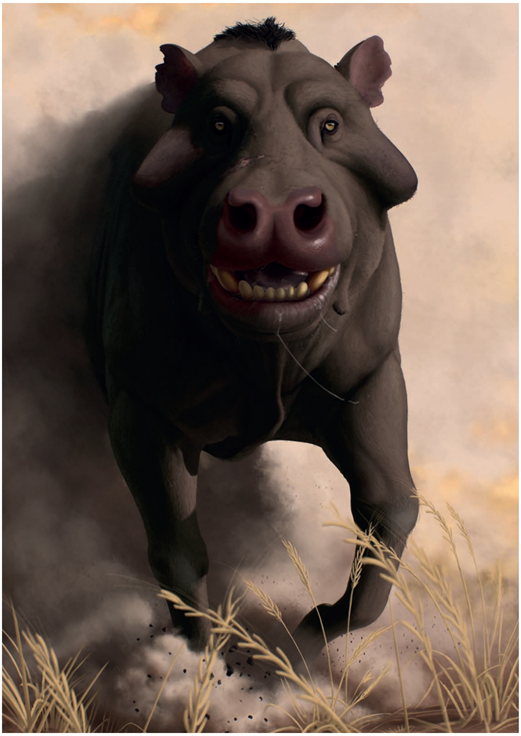
- **Digital | 2017**



SPINOSAURUS AEGYPTIACUS

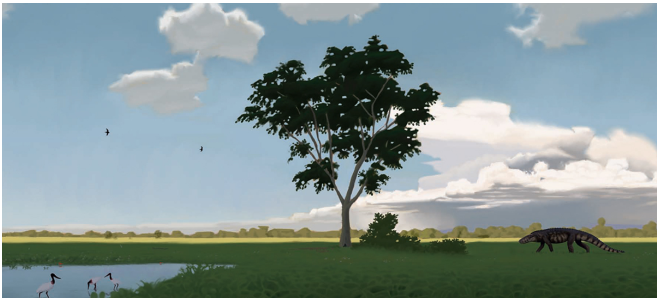
Spinosaurus may well end up being the most frequently illustrated Mesozoic dinosaur – probably after *Tyrannosaurus* – of the current age. Nevertheless, there is always something new that the innovative palaeoartist can bring to a reconstruction of even the most familiar animal. Here, low sunlight emphasises the animal's bulk and broad abdomen.

- **Digital | 2020**



CONFRONTING HELL
Around 20 million years ago, the bison-sized entelodont *Daeodon* roamed North America. With limbs suited for fast running, a skull up to 90cm long and teeth built for an omnivorous diet, *Daeodon* was surely dangerous to smaller animals and was quite unlike anything alive today. The idea behind this piece is that a time-travelling camera team has caught the animal's attention and perhaps this represents the last moments those people successfully recorded on camera.

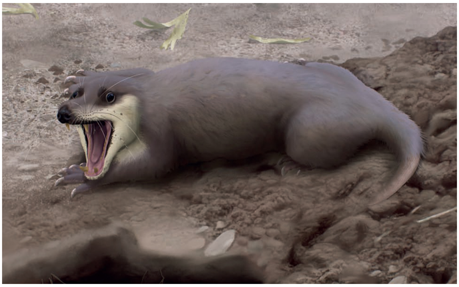
• Digital | 2022



MIDDAY

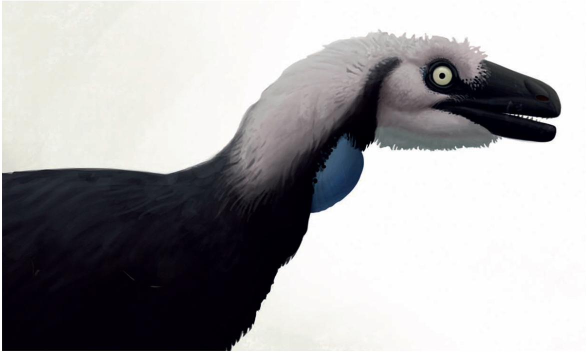
On a South American floodplain 13 million years ago, the great sebecosuchian croc *Barinasuchus* heads for a pool, already the haunt of jabiru-like storks. *Barinasuchus* was named in 2007 and only recently have its absurd proportions become known outside specialist research circles. Its skull was around 1m long, suggesting a total length of 6m. We know all too little about sebecosuchians, and their fossils remain rare.

• Digital | 2021



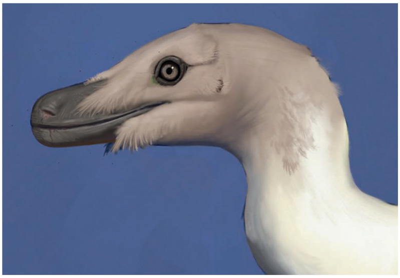
ON THE DEFENSIVE
A male *Thrinaxodon* takes a break from tunnelling to threaten a potential attacker. Known from the Early Triassic of Antarctica and South Africa, *Thrinaxodon* was a cynodont – the group of synapsids from which mammals are derived. Its fossils are known from rocks close in age to the mass extinction event that devastated the globe at the end of the Permian; it's very possible that its ability to burrow allowed *Thrinaxodon* to survive the catastrophe.

• Digital | 2018



ORNITHOLESTES BUST
Many theropods probably possessed striking colour patterns, as shown in this speedpaint of the Late Jurassic North American maniraptoran *Ornitholestes*. The colourful eye, inflated throat-sac and two-toned pattern suggest an animal that uses posture, sound and display to send signals. *Orntholestes* classification is somewhat confused; it has been suggested that it is a very early maniraptoran but also that it might be an early member of the oviraptorosaur lineage. However, some studies suggest that it is perhaps an early member of the oviraptorsaur lineage.

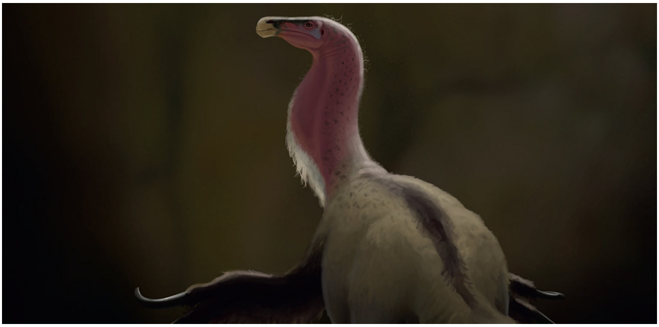
• Digital | 2021



VELOCIRAPTOR

Many who reconstruct extinct animals know that some of their subjects can have a surprisingly gentle, even friendly appearance when depicted with their soft tissues. *Velociraptor* may well have been beautiful, the male individual shown here looking fine in his white splendour. The females may have been entirely different in hue and pattern, so the males could be spotted from afar. Exactly this technique is used in some steppe-dwelling birds today.

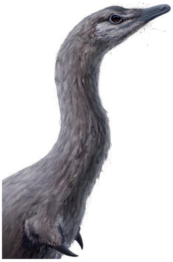
• Digital | 2017



SUNBATHING MALE *THERIZINOSAURUS*

Therizinosaurus from Late Cretaceous eastern Asia remains an irresistible subject for artists, given its anatomy and size – around 10m long, similar in mass to *Tyrannosaurus* and in possession of giant claws (only subtly shown here). Midiaou's art shows the giant sunbathing just as birds do, many of which adopt spread-winged poses to capture the rays.

• Digital | 2017 (Updated 2021)



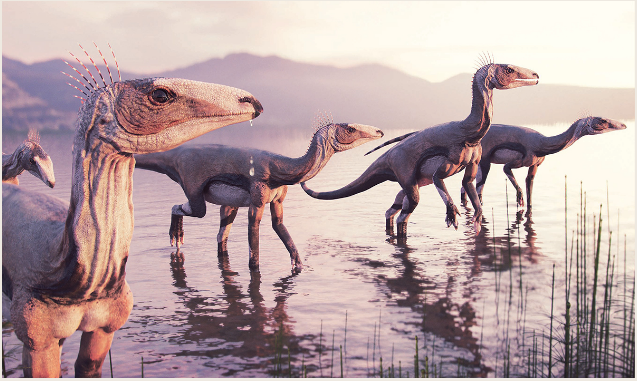
LINHENYKUS

Linhenykus monodactylus, named from China in 2011, is one of the alvarezsaurids, a group of long-legged, lightly built maniraptoran theropods noted for their pick-like forelimbs. Most were around 1m long. The enlarged thumb claw – visible here – probably had a role in digging, and social insects like termites were probably among their favoured prey.

- **Digital | 2017 (Updated 2022)**

POLAND

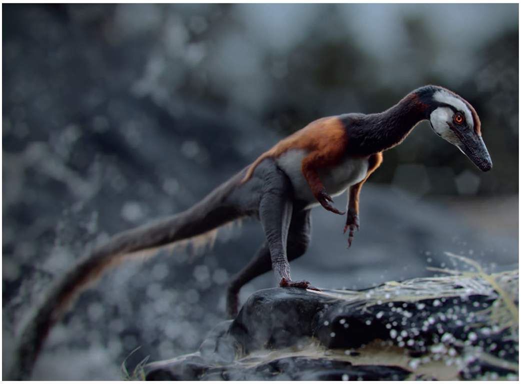
JOANNA KOBIERSKA



***SILESAURUS* IN WATER**
At a Polish lake on a Triassic morning 215 million years ago, something catches the attention of a group of *Silesaurus opolensis*. Silesaurids were quadrupedal, lightly built Triassic archosaurs, some of which had jaws and teeth suited for plant-eating, or at least omnivory. Current studies indicate that silesaurids were close cousins of dinosaurs.

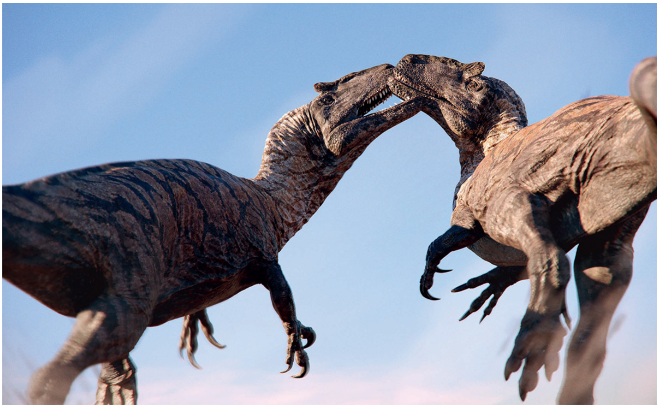
- **Digital 3D | 2020**

JOANNA IS A 3D ARTIST from Poland who, for the last three years, has studied Game Design at the University of Silesia and now works as a 3D generalist in advertisement. Although she only produces palaeoart in her free time, in 2020 she won the Symposium of Vertebrate Palaeontology's prestigious Lanzendorf/National Geographic PaleoArt Prize in Digital Modelling and Animation. One of her pieces was also chosen by the Blender Foundation for the splash image of the 2.92 version of Blender software.



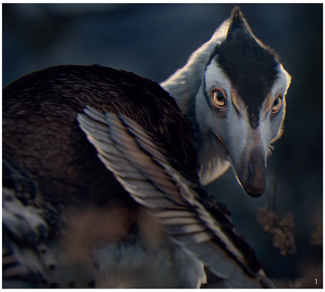
COMPSOGNATHUS LONGIPES
Small coelurosaurs like this compsognathid were lightly built, long-tailed animals with feathery bodies, but lacking the dense, bird-like plumage of maniraptorans like *Velociraptor*. Compsognathids were predators of small animals, but would have been prey items themselves. Consequently, their colour patterns would probably have been cryptic to aid in their concealment. (Used courtesy of Facts: Dinosaurs.)

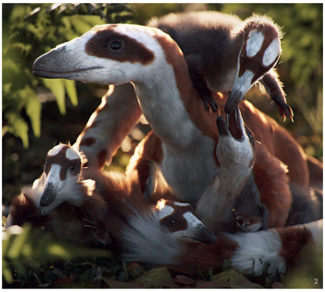
- **Digital 3D | 2021**

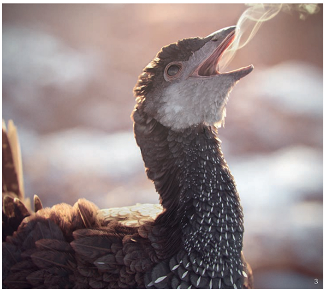


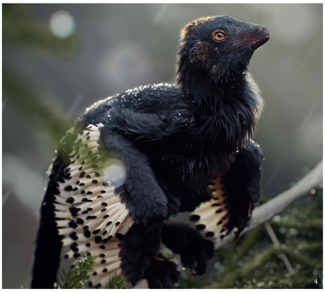
DANCING *ALLOSAURUS*
The behaviour of the two *Allosaurus* here is in keeping with scientific data showing that large predatory dinosaurs deliberately bit or mouthed one another about the face and snout. Sometimes this may have been aggressive, but on other occasions it could well have been playful, friendly or sexual. (Used courtesy of Facts: Dinosaurs.)

• Digital 3D | 2021



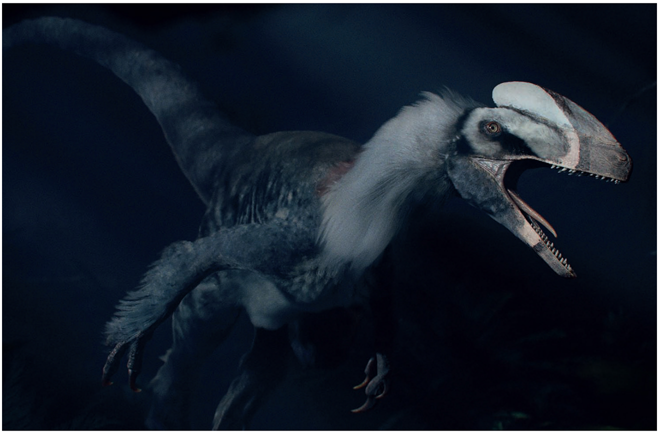






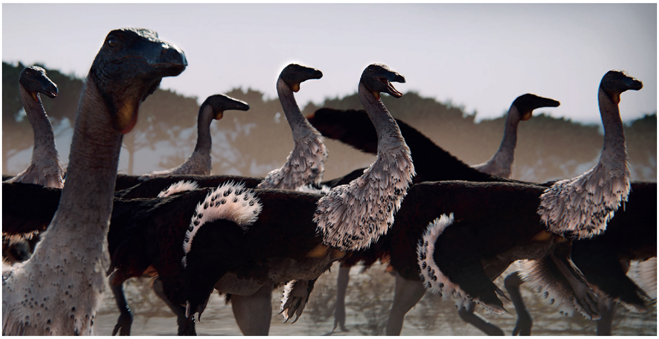
1) *VELOCIRAPTOR MONGOLIENSIS*, Digital 3D | 2020
2) *SINOSAUROPTERYX PRIMA FAMILY*, Digital 3D | 2021
3) *CROWING ASTERIORNIS MAASTRICHTENSIS*, Digital 3D | 2022
4) *ANCHIORNIS HUXLEYI IN THE RAIN*, Digital 3D | 2021

If Joanna is known for one set of subjects, it's feathered theropod dinosaurs. The fossil record indicates that many of these animals – including the famous *Velociraptor* – looked uncannily bird-like in overall form but also in many detailed aspects. Some also lived in places similar to those inhabited by superficially similar birds today. Modern bustards, for example, are vaguely similar in shape, form and habitat to *Velociraptor*, so it seems appropriate that they might serve as inspiration for depictions of such animals, as is the case here. Cryptic markings – like the striped tail and 'bandit mask' depicted here on the compsognathid *Sinosauropteryx* (top right) – help bring these animals to life, to make them look more like real animals.



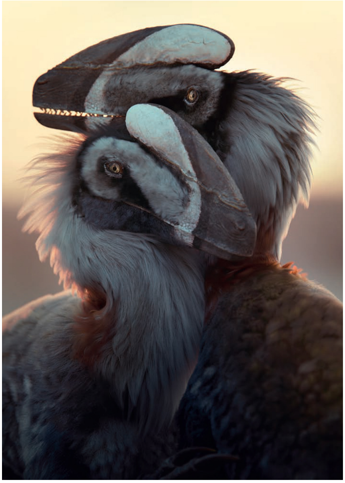
GUANLONG WUCAII
The Late Jurassic tyrannosauroid *Guanlong* was described from China in 2006. Like most early members of the tyrannosaur family, *Guanlong* was mid-sized, at about 3m long. Its most conspicuous feature was its narrow, prominent crest. Dinosaurs repeatedly evolved unusual headgear, seemingly used in visual signalling, and mostly in social and sexual display. (Used courtesy of Facts: Dinosaurs.)

- **Digital 3D | 2021**



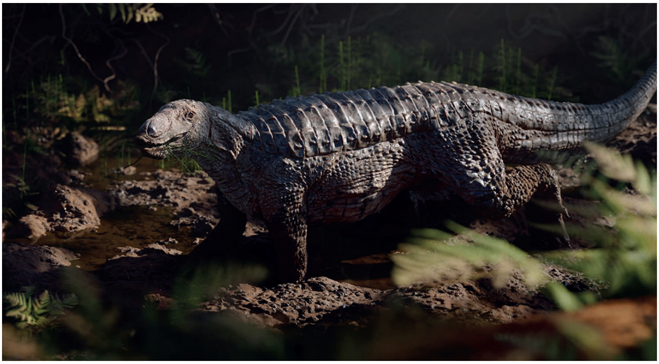
FLOCK OF *GALLIMIMUS BULLATUS*
Ornithomimids are a Cretaceous group of the northern continents, with toothless jaws, and long necks and legs. Specimens of several species have been preserved together, suggesting herding behaviour. Fossils show that ornithomimids bore long, hair-like filaments over most of the body (bar the legs), and large feathers on the forelimbs.

- **Digital 3D | 2021**



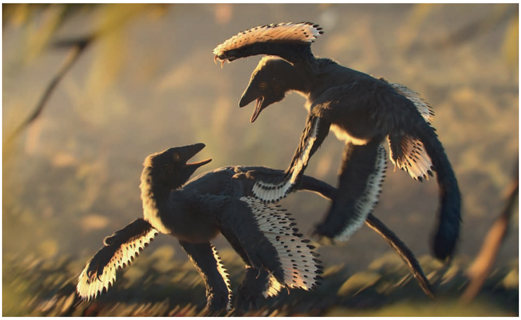
GUANLONG WUCAII **PAIR**
The idea that dinosaurs such as the tyrannosauroid *Guanlong* might snuggle up together may once have been dismissed as fanciful or sentimental. However, many crocodylians and birds make close physical contact at certain times, and the affinity that tyrannosauroids have with birds makes this behaviour entirely plausible. (Used courtesy of Facts: Dinosaurs.)

• Digital 3D | 2021



STAGONOLEPIS OLENKAE
For most of the Triassic, the dominant large land animals were crocodile-like archosaurs called crurotarsans, amongst which were the aetosaurs. This group – which includes *Stagonolepis*, shown here – was (probably) omnivorous, quadrupedal and armour-plated; the biggest reached 6m in length. Past reconstructions of aetosaurs usually showed flattened or upturned snouts, yet recent research suggests the bulbous, convex snout region portrayed here.

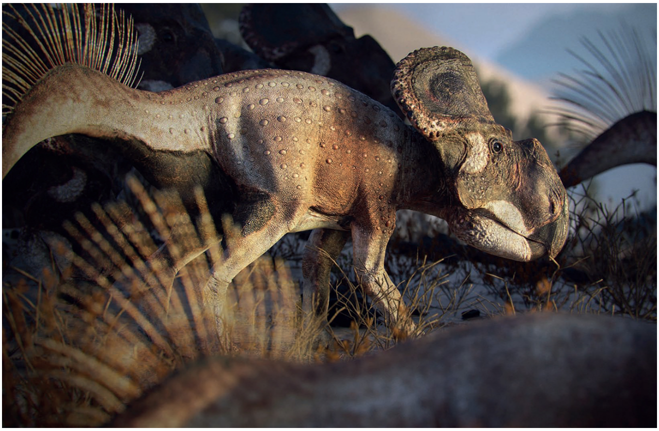
• Digital 3D | 2021



ANCHIORNIS HUXLEYI

The crow-sized *Anchiornis* from Jurassic China – a close relative of the iconic *Archaeopteryx* – is one of the first Mesozoic dinosaurs in which direct evidence of pigmentation was discovered. It seems to have had a reddish head crest, and a combination of greys and blacks on its wings and body.

• Digital 3D | 2021



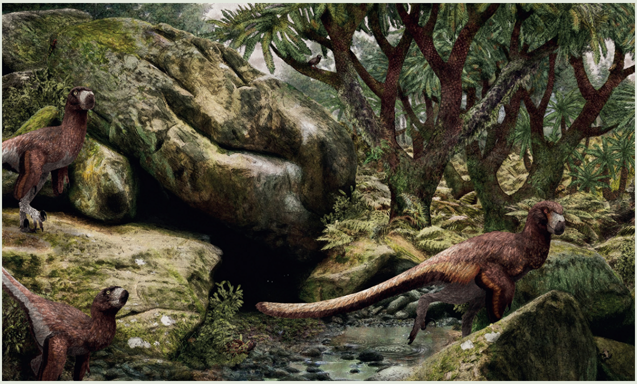
PROTOCERATOPS ANDREWSI

Protoceratops from the Late Cretaceous of the Gobi Desert is one of the world’s best-known ceratopsian dinosaurs. It was surprisingly tall and leggy, and its large frill and deep nasal region probably played key roles in signalling and display. The spine-like structures on the tail are not known for *Protoceratops* but are found on the older, bipedal ceratopsian dinosaur *Psittacosaurus*.

• Digital 3D | 2020

UK

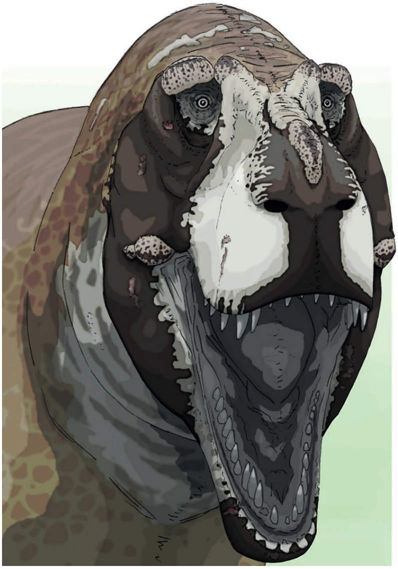
JED TAYLOR



***DEINONYCHUS* FAMILY**
A family of the dromaeosaurid *Deinonychus*, including an adult and two subadults. The discovery of this species, in Lower Cretaceous rocks of the American Midwest, was instrumental in igniting what became known as the Dinosaur Renaissance. The animal has undergone numerous reinterpretations of its appearance, and Jed's reconstruction represents the cutting edge of current thinking.

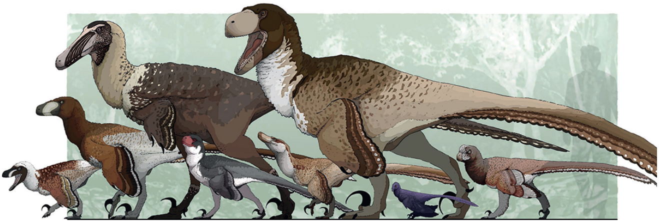
- **Pencil and digital | 2021**

AFTER STUDYING ANIMAL BIOLOGY at university, Jed became a wildlife artist before transferring almost completely to palaeoart in 2017. He has worked on illustrations for several upcoming book projects, press releases and exhibition signage, as well as creating designs for clothing. He uses various styles and media, ranging from bright and bold graphics to finely rendered pencil drawings. His highest honour, he believes, was presenting his work at TetZooCon in 2019.



STAN THE *T. REX*
‘Stan’ was discovered in South Dakota in rocks belonging to the Upper Cretaceous Hell Creek Formation. Currently the fifth most complete *T. rex* known, ‘he’ (gender assignment in *T. rex* remains uncertain) holds quite the accolade in being the most expensive fossil ever: he was sold in 2020 for $31.8 million, apparently to a new natural history museum in Abu Dhabi.

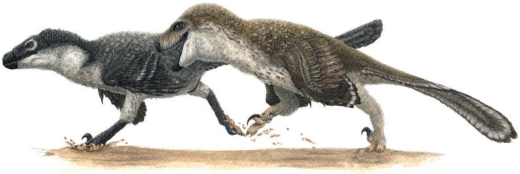
- **Pencil and digital | 2019**



DROMAEOSAURIDS

This montage shows (left to right): *Acheroraptor*, *Deinonychus*, *Austroraptor*, *Atrociraptor*, *Utahraptor*, *Velociraptor*, *Microraptor* and *Zhenyuanlong*. It beautifully conveys the diversity in form and size that exists within this exciting group (note the human silhouette at right). Dromaeosaurids persisted for more than 100 million years and occurred on most continents; different lineages within the group had highly distinctive evolutionary histories.

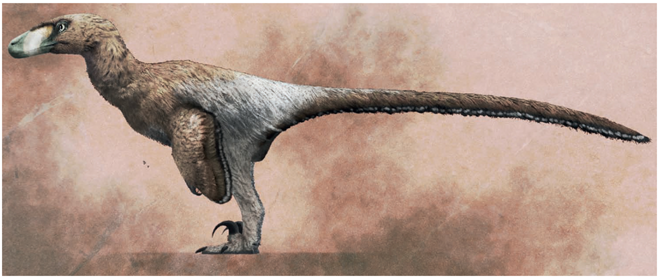
• Pencil and digital | 2019



CHASE

A dromaeosaurid sees off a troodontid. Both groups shared a broadly similar distribution, and whilst they may have had separate ecological niches (troodontids seem to have preferred smaller prey), clashes such as these are a regular fixture amongst predator guilds today. There can be little doubt they occurred in the Mesozoic too.

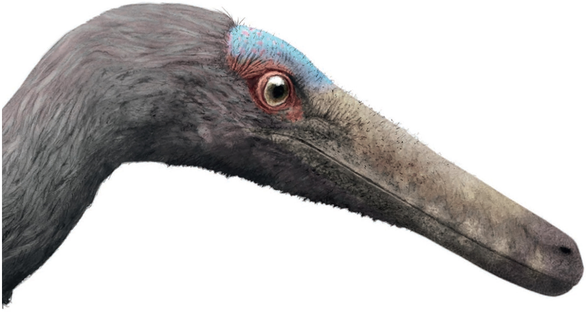
- **Pencil and watercolour | 2018**



DEINONYCHUS

It is fair to say that palaeoartists – and scientists too – have struggled in knowing how to depict the plumage of dromaeosaurids and other feathered maniraptoran dinosaurs. A very real possibility is that sections like the forelimb and tail were 'streamlined', with a confluent, tidy plumage like that seen in some bird groups. This is well illustrated in this profile of *Deinonychus*.

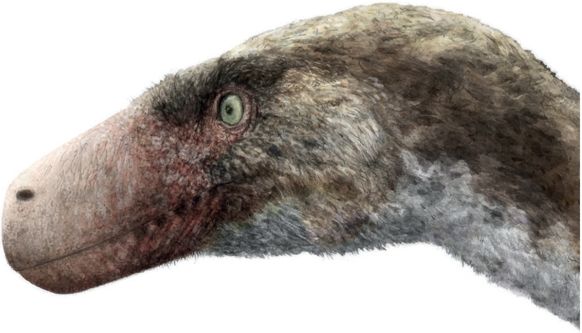
• Pencil and digital | 2021



BUITRERAPTOR

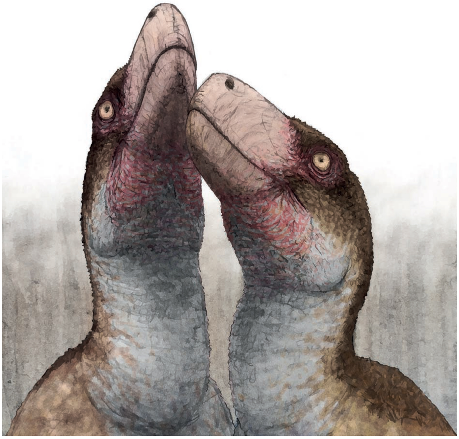
The unenlagiines were remarkably long-snouted dromaeosaurids. The anatomy of their teeth suggests fish-eating habits, and their relatively long, slender legs imply either wading or excellent running abilites (or both). Unenlagiine facial anatomy is exemplified here by *Buitreraptor* from the Late Cretaceous of Argentina, named in 2005. At 1.5m in length, it's one of the smallest members of the group.

- **Pencil and digital | 2021**



UTAHRAPTOR PROFILE
Utahraptor has a rather more ‘boxy’ head than its shallow-snouted relatives, like *Velociraptor* and the unenlagiines. These animals surely had some binocular vision, but how ‘forward-pointing’ their eyes were requires educated guesswork. No skin integument has yet been reported for *Utahraptor* so the covering depicted here remains speculative. It is, however, informed by the presence of feathers in other dromaeosaurids.

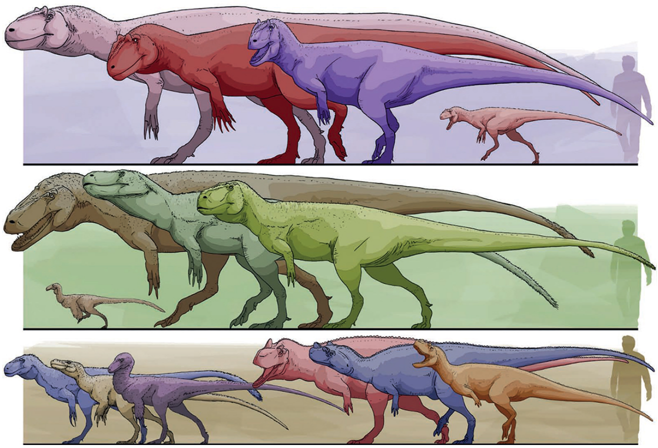
• Pencil and digital | 2022



UTAHRAPTOR PAIR

Excavations in Utah in 2001 led to the amazing discovery of at least seven individual *Utahraptor* specimens, ranging from 4.8m-long adults to much younger animals only a metre or so in length, all associated with iguanodontian remains. This may imply some kind of social behaviour – a *Utahraptor* pack sharing a kill – or perhaps a predator trap, where the carnivores were lured individually into quicksand or mud while trying to scavenge the carcass of the iguanodontian. Further work on the find will hopefully provide more answers.

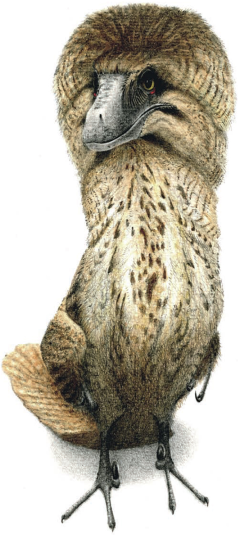
- **Pencil and digital | 2022**



MORRISON THEROPODS

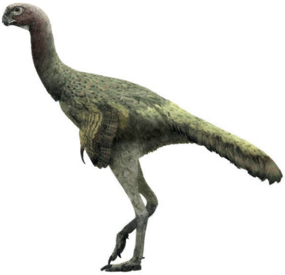
A cavalcade of theropods from the renowned Upper Jurassic Morrison Formation that covers a great deal of Midwest North America and is one of the richest dinosaur-bearing geological units in the world. Included are (top) various species of *Allosaurus*; (middle) *Torvosaurus* and *Ornitholestes* (small, at front); and (bottom) *Marshosaurus*, *Stokesosaurus*, *Tanycolagreus* and *Ceratosaurus*. The tradition whereby contemporary animals are shown alongside one another is incredibly useful for artists and researchers alike.

- **Pencil and digital | 2019**



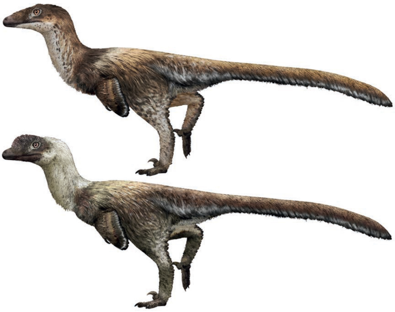
VELOCIRAPTORINE
A velociraptorine as a Great Bittern. Palaeoartists often model dromaeosaurid colours and markings in line with modern birds such as pheasants, grouse and partridges. This is logical as, in a broad sense, they shared similar habitats. Bitterns may be more associated with wetlands than are velociraptorines, but vague similarities are still evident.

- **Watercolour and pencil | 2017**



AVIMIMUS
This small but bird-like theropod is known from Mongolia's Upper Cretaceous Barun Goyot Formation. It is an oviraptorosaur; it was toothless and equipped with a parrot-like beak and long legs (features typical within the group). It was probably a fast runner, able to sprint across the sand dunes of the Barun Goyot environment.

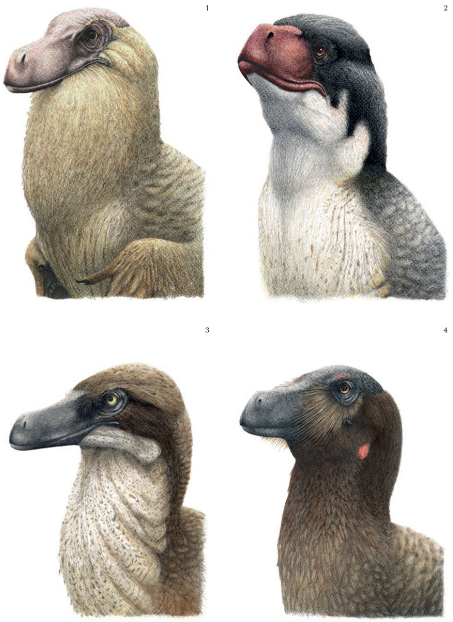
- **Pencil and digital | 2021**



TROODONTIDS

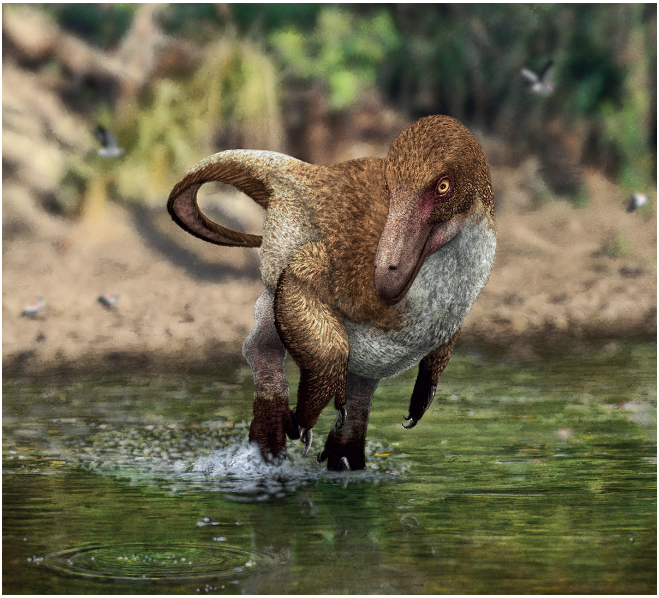
Once poorly known – early remains were thought to be pachycephalosaurs – troodontids are now known from throughout the Cretaceous (*Hesperornithoides*, the earliest, dates back to the Late Jurassic). Teeth from Alaska also suggest troodontids inhabited the Late Cretaceous Far North; this pair would look very at home in the High Arctic summer.

• Pencil and digital | 2021



DROMAEOSAURID PORTRAITS
One of the most exciting ideas about animals like dromaeosaurids is that even closely related species might have differed markedly in pigmentation, plumage or soft facial anatomy. Jed has experimented with that idea here – his reconstructions mirroring the sorts of intra-familial variation we see in modern bird families. Here we see 1) *Tsaagan*; 2) *Atrociraptor*; 3) *Acheroraptor*; and 4) *Linheraptor*.

• Watercolour and pencil | 2018



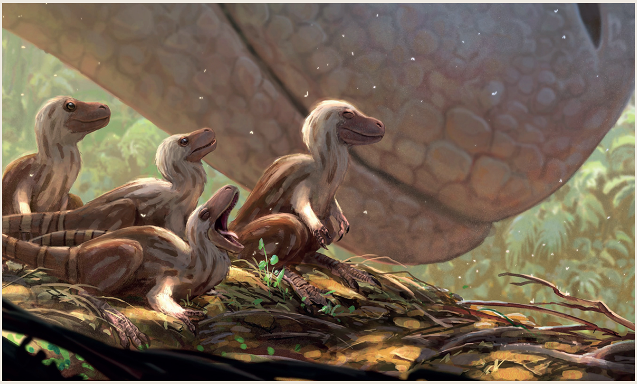
UTAHRAPTOR INVESTIGATES

Utahraptor might not be an unenlagiine, but it would probably be able to capture prey in water, as can so many living land-based predators. Size estimates vary, but *Utahraptor* was large – anywhere between 5–7m long and perhaps weighing 300–500kg. This probably discounts *Utahraptor* from the raptorial hunting strategies of smaller dromaeosaurids; perhaps it was, instead, an ambush hunter of larger prey, more reliant on its jaws than the infamous 'sickle claw'. Its repertoire might have also included a spot of fishing. The use of an out-of-focus background and reflective, colourful water surface gives the piece the feel of a wildlife photo.

- **Pencil and digital | 2021**

COLOMBIA

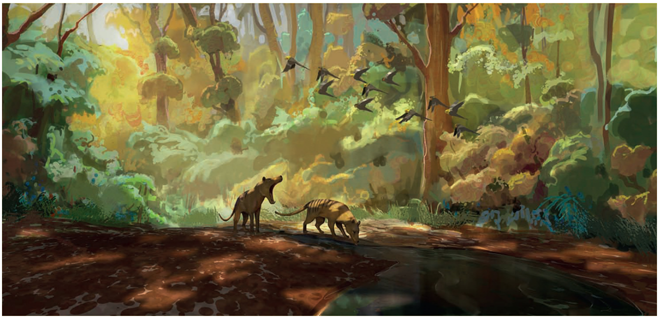
PABLO RIVERA



TYRANNOSAUR HATCHLINGS
There's little doubt that hatchling tyrannosaurs were cute, though it must be said at this point that we don't know for sure. One of the Holy Grails of dinosaur palaeontology is to find a *T. rex* nest, assuming, of course, that such a thing exists. Tyrannosaurids underwent conspicuous changes as they grew, even occupying different ecological niches at different growth stages.

- Digital | 2020

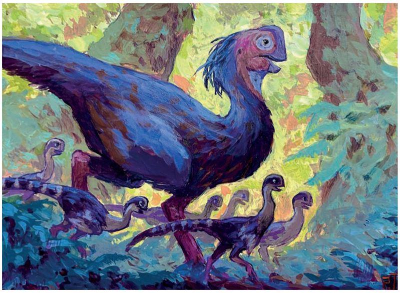
ORIGINALLY FROM CALI, Colombia, Pablo was fascinated from a young age not just by the idea of dinosaurs, but especially their depictions in film. Movies such as *The Land Before Time*, Disney's *Dinosaur*, and *Walking with Dinosaurs* all served to bring to life the species whose names and likenesses he painstakingly memorised from books. An interest in palaeontology developed alongside a passion for animation, and dinosaurs remained a favourite subject matter throughout his years studying art. Now, Pablo finds himself in the enviable position of spending his days as a visual development artist for animated films, whilst his evenings are often devoted to what got him started on this path in the first place: drawing and painting dinosaurs.



THYLACINE

The Thylacine is one of the icons of extinction. Wiped out on the Australian mainland before European settlement, it was persecuted to extinction sometime after 1936 on its last stronghold, Tasmania. It was unusual in being one of only two marsupials in which both sexes had a pouch (the other is the extant South American Water Opossum).

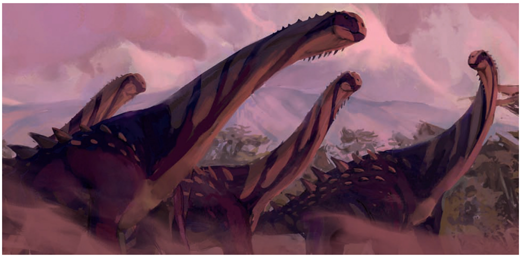
- **Digital | 2020**



CITIPATI STROLL

Pablo enjoys returning to traditional media on occasion, as this painting of a *Citipati* parent and brood illustrates. *Citipati* is an oviraptorid theropod whose fossils (from Upper Cretaceous Mongolia) have been found in an avian brooding posture over clutches of eggs, some of which preserve the remains of embryos.

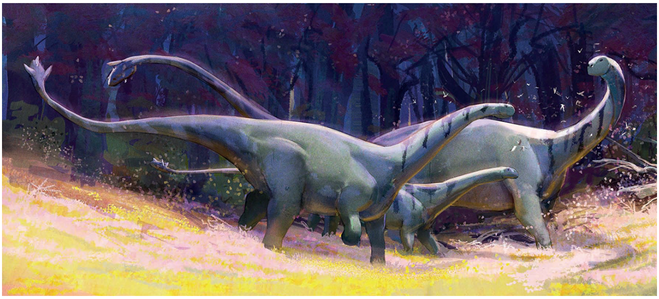
- **Acrylic on paper | 2022**



LONG NECKS AND SUNSET

Currently the last-known western North American sauropod, *Alamosaurus sanjuanensis* is a titanosaur known from various fragmentary remains. Accurately gauging its appearance and size has been problematic, although it appears to have been a giant. Studies from 2015 indicate the presence of bony osteoderms, but their arrangement remains unknown. Pablo's interpretation of body-amour shown here is speculative.

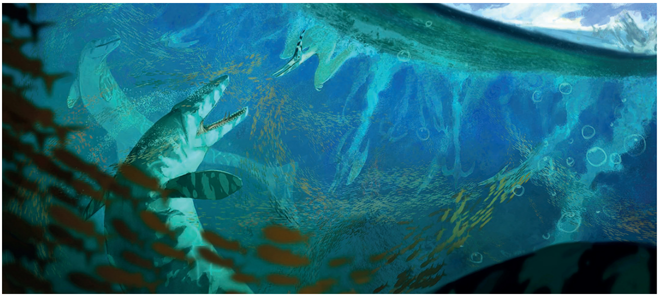
- **Digital | 2021**



AMBER FIELD

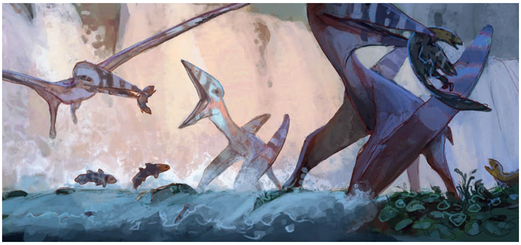
The medium-sized (10m long), short-necked sauropod *Shunosaurus* is known from near-complete fossils from the Upper Jurassic of China. Whether it moved in mixed-age herds, as Pablo has shown here, is currently unknown, but footprint evidence shows that some sauropods certainly did. *Shunosaurus* is also known for its double-spiked tail club.

- **Digital | 2019**



SEA TYRANTS
Tylosaurus proriger – one of the biggest of the sea-going mosasaurs – was an apex predator from the Western Interior Seaway that bisected North America during the Cretaceous. Growing up to 16m in length, its presence has come as a shock to the pterosaur *Pteranodon,* diving in pursuit of prey. Now the hunter is the hunted.

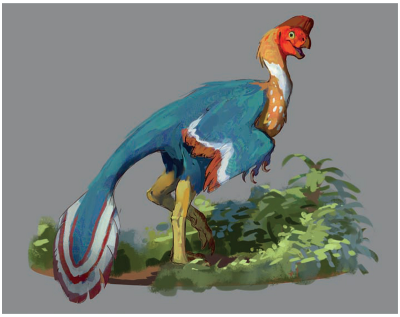
• Digital | 2021



HATZEGOPTERYX

This Late Cretaceous giant azhdarchid pterosaur may well have evolved in line with Foster's Rule: that organisms isolated on islands can become dwarves or giants. In this case, it was the latter. *Hatzegopteryx* is named after Hateg Island – now part of modern Romania – where, in the absence of large theropod competitors, this pterosaur became a terrestrial apex predator with a broad diet that perhaps included fish and small dinosaurs.

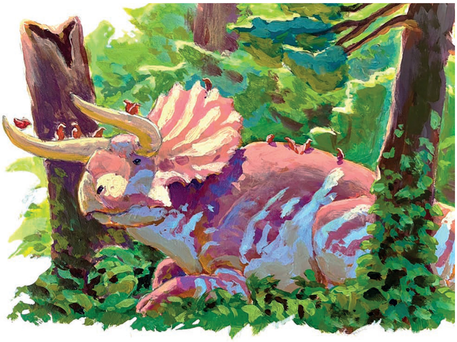
• Digital | 2020



OVIRAPTOR

Oviraptor was the first-known member of its group and it was initially misconstrued as an egg predator when first discovered. Today, we know that the eggs and nests it was associated with are its own, not those of another dinosaur – numerous oviraptorosaur specimens sat on top of egg-filled nests have now been discovered. With its strange jaws and beak, its diet remains speculative. Suggested food includes nuts and molluscs; ironically, eggs have not been discounted.

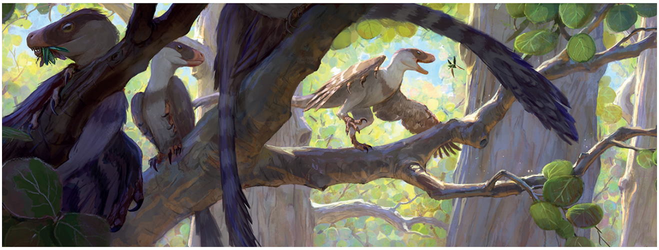
• Digital | 2021



LOUNGING MONARCH

A lush painting of *Nasutoceratops titusi*, a centrosaurine ceratopsid from the Late Cretaceous of Utah. An average-sized horned dinosaur about 4.5m in length, its skull is far from ordinary, with a very deep snout and two large brow-horns spread out in an almost bovine fashion – a so-far singular arrangement amongst the ceratopsids.

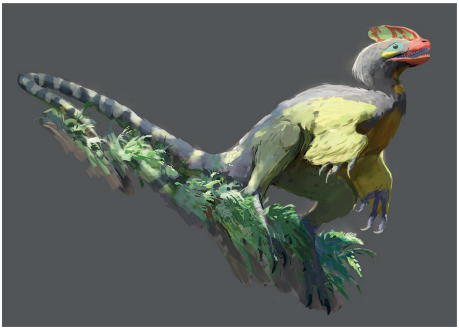
• Acrylic on paper | 2021



RAPTO R TREE

These juvenile *Deinonychus antirrhopus* are enjoying some arboreal capers. Evidence suggests that adult dromaeosaurids did not climb. Among living animals, it's worth noting that even such ill-adapted climbers as Cheetahs climb regularly – albeit clumsily and not too high – as juveniles. As such, this concept is not outside the realms of possibility.

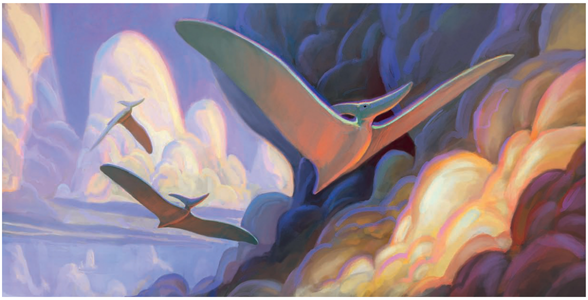
• Digital | 2022



GUANLONG WUCAII

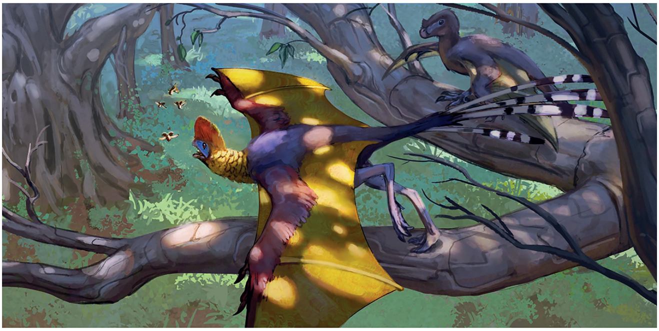
A personal piece by Pablo, this time a birthday card showing the proceratosaurid theropod *Guanlong* from Late Jurassic China. Around 3m long, *Guanlong* had a distinctive crest. While no traces of a feathery covering are known, other small tyrannosauroids – the broader group to which proceratosaurids belong – such as *Dilong*, were definitely feathered. It is therefore reasonable to assume that *Guanlong* was similarly covered.

• Digital | 2020



WINGS
A stylised illustration of the famous Late Cretaceous pterosaur *Pteranodon longiceps*. This is more interpretive art than disciplined palaeoart, but it evocatively captures the feeling of flight high up amongst sunlit clouds. With its flamboyant crest, *Pteranodon* is the public's go-to image of a 'flying reptile' and is a pop-culture staple.

- **Digital | 2019**



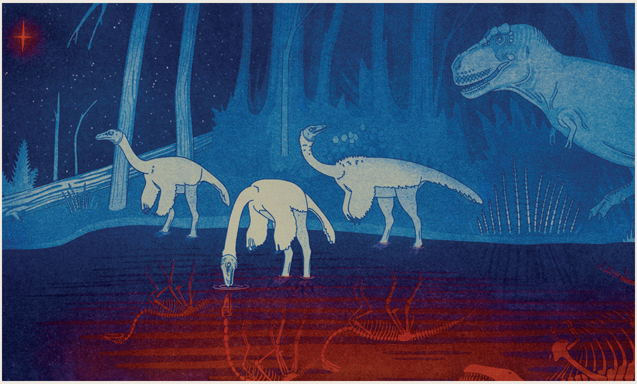
BALANCING ACT

Yi qi caused a sensation when announced in 2015. This little theropod is a scansoriopterygid – a family whose members are considered arboreal climbers. Even within this group, *Yi* is unusual due to its bat-like forelimbs; the single known fossil includes skin membranes preserved between the long fingers. Other theropods possess a more avian configuration to their limbs.

• Digital | 2020

CANADA

GREER STOTHERS



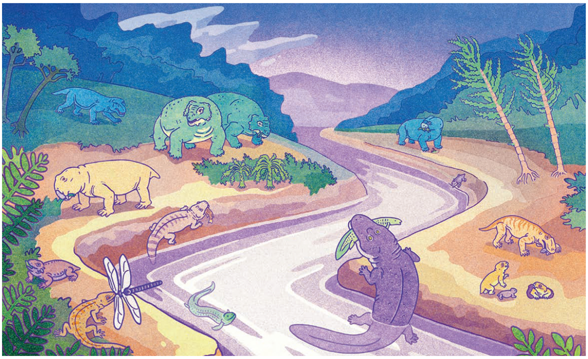
THE NIGHT BEFORE

In the Hell Creek fauna of North America, a *Tyrannosaurus* emerges from the woods to join three *Ornithomimus* drinking from a lake. It is the last peaceful night before the K-Pg impact, with the asteroid appearing as a red star in the sky. In its light, those fated to die are marked. This poignant piece emphasises Greer's minimalist semi-schematic style and the watercolour-like feel of their Risograph printmaking method.

- **Risograph print | 2022**

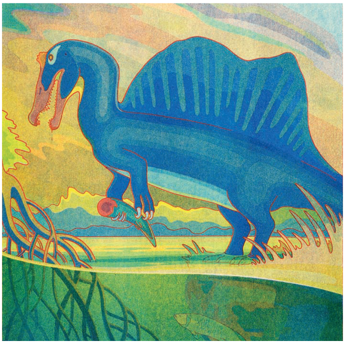
BORN AND RAISED IN TORONTO, Greer graduated from Sheridan College, Ontario, with an Honours Bachelor of Illustration in 2016. That same year, they won the Thomas E. Bolton Award for a talk on historical palaeoart at the Canadian Palaeontology Conference. Their palaeoart also garnered the Applied Arts Youngblood Illustration Award, iJUNGLE Merit Award and Spark Box Studio Emerging Artist

Award. Between 2017 and 2018, Greer studied Evolutionary Biology at the University of Toronto as a non-degree student, during which time they also provided illustrations for the Royal Ontario Museum, followed by artwork for the Evolving Planet exhibition at Chicago's Field Museum of Natural History in 2019. Greer's children's book, *Kaleidoscope of Dinosaurs and Prehistoric Life*, explains the coloration of dinosaurs.



LIFE IN THE PERMIAN
An illustration commissioned by the Chicago Field Museum shows a lush landscape before the Permian mass extinction event. We see ecological interactions occurring between certain species depicted, which include: (top left) *Rubidgea* and *Pareiasaurus*; the browsing *Lystrosaurus* and *Procolophon*; and *Milleretta* (with dragonfly). *Uranocentrodon* has caught an actinopterygian fish. On the opposite riverbank, a *Rhinesuchus* carries off a lungfish, while a *Lycaenops* hunts the little burrowing *Diictodon*. In the distance is the large dicynodont *Aulacephalodon*. Flora includes the seed fern *Glossopteris* and *Calamites* horsetails.

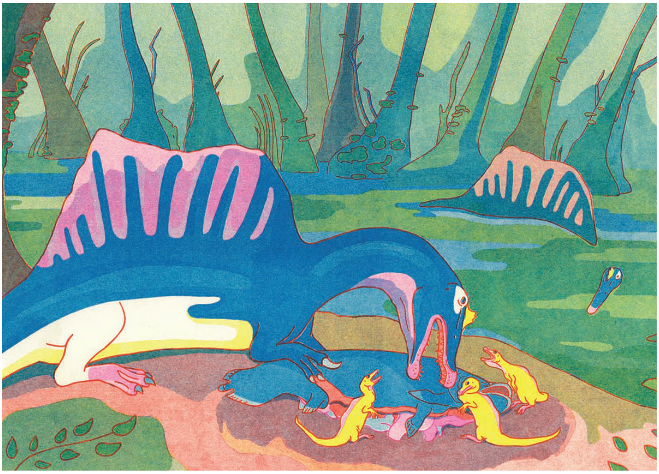
- **Risograph print | 2019**



THE GOLDEN HOUR

Here capturing a neoceratodontid lungfish *Neoceratodus* at dusk (or perhaps dawn), the Late Cretaceous North African theropod *Spinosaurus* ranks as a palaeoart superstar of the modern age. Controversies surround its anatomy, way of life, and even species-level taxonomy. Whether it was an active swimmer, a heron-like wader, or even a hippo-like bottom-wader, its proportions indicate that it could still stand like this.

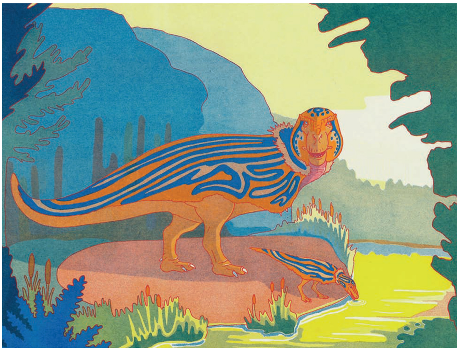
- **Risograph print | 2020**



BOG BRUNCH

For all the recent discussion surrounding *Spinosaurus*, we essentially know nothing of its life cycle. However, many archosaurs living today (birds and crocodylians) are excellent parents, and here Greer has speculatively implied that adults may have provided meals for their juveniles. The young look so different from their parents that they might be misidentified as members of a different species, a phenomenon that appears to have been widespread in dinosaurs.

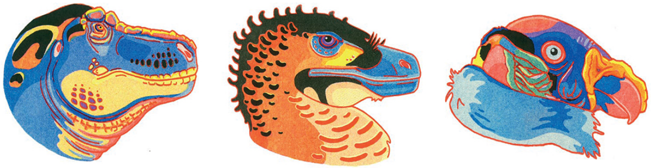
- **Risograph print | 2017**



WATCHFUL MOTHER

Before the discovery of *T. rex* skin impressions, a feathery coat seemed a plausible (and fanciful) possibility. This parent and her chick both wear the stripes of juvenile emus, an adaptation to help with camouflage. This scene is framed from the point of view of an animal stealthily watching the predators, but who has just been spotted by the vigilant mother.

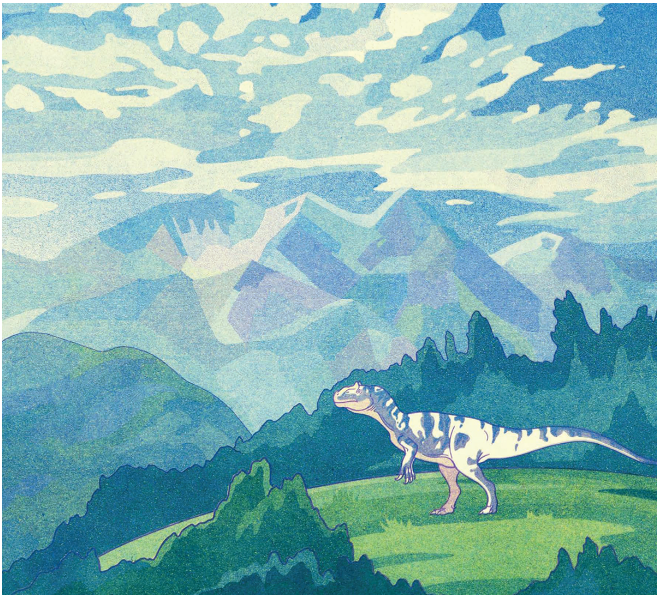
- **Risograph print | 2016**



COELUROSAURIA

This set of theropods was an attempt to make animals from the past (*Tyrannosaurus* and *Deinonychus*) look as absurd as an animal from the present (*Vultur*, the King Vulture). Recently, a vague and entirely coincidental resemblance has been noted between some reconstructions of Mesozoic dinosaurs and the griffons and dragons of heraldry. Here's a great case in point.

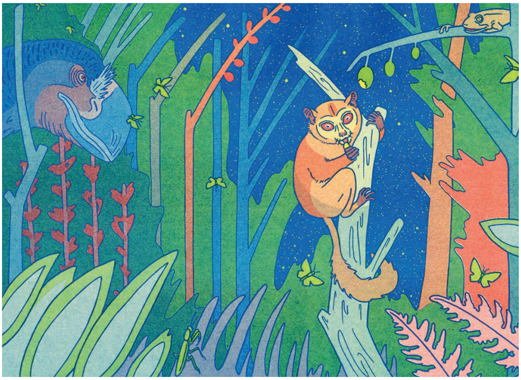
- **Risograph print | 2019**



PIEBALD

This piece was commissioned to show a dinosaur in the client's favourite location: Lauterbrunnen, Switzerland. Most of our information on dinosaurs comes from fossils found in lowland environments, like floodplains and lakes. Yet they must surely have occurred in highlands and mountains too. Greer wanted the *Allosaurus* to reflect the patterns in the sky above, so it was given a speculative piebald coloration, referenced from captive-bred alligators with that mutation.

• Risograph print | 2020



NIGHT LIFE

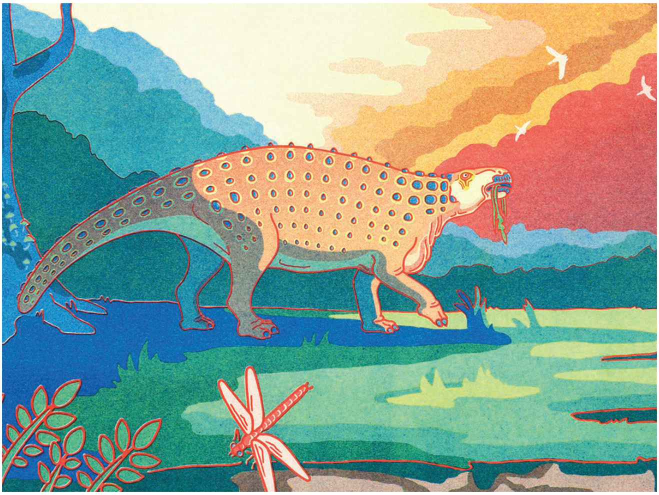
This print was commissioned by an anthropologist with an interest in primate evolution. The great bird *Gastornis* – formerly called *Diatryma* – seems to be eyeing a *Necrolemur* (right) as a potential prey item, though perhaps it is more interested in foraging on plant material, since current thinking posits *Gastornis* as a herbivore. The flat, overlapping leaves and branches were inspired by the stiff, surreal vegetation of Henri Rousseau.

- **Risograph print | 2019**

CERATOPSIA

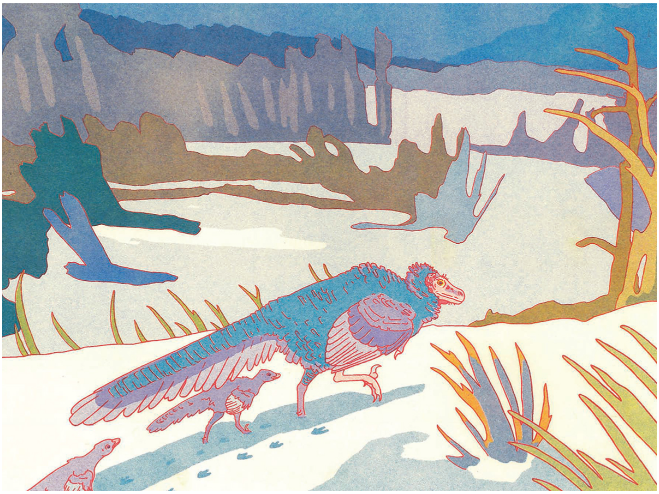
The All Yesterdays movement, which encourages highly speculative use of soft tissue and colouring, was the inspiration behind these busts. Here, Greer applied the colours and patterns of butterflies and moths to the frills of the ceratopsians *Triceratops*, *Protoceratops*, *Sytracosaurus* and *Wendiceratops*. These looks might be technically unlikely, but they're attractive and entertaining nonetheless.

• Risograph print | 2016



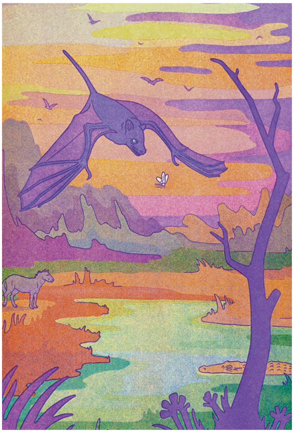
THE DURHAM ANKYLOSAUR
This illustration of the Australian ankylosaur *Minmi* is based on the composition of a nineteenth-century livestock painting, *Etching of the Durham Ox* by John Boultbee. Stomach contents and information from tooth microwear shows that ankylosaurs mostly ate low-growing plants like ferns, but there are some indications that they were flexible and adaptable feeders. In the distance are several *Anhanguera*-like pterosaurs.

- **Risograph print | 2019**



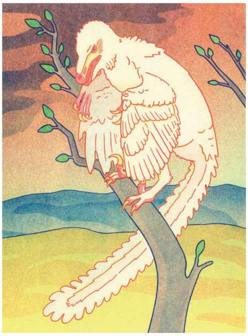
WINTER STROLL
The landscape here is modelled on the field behind the home of Greer's parents. The wild turkeys that stroll through the premises made Greer think of how this scene would look millions of years ago, with the turkeys of today replaced by a family of *Saurornitholestes*. The highly bird-like form of these Late Cretaceous maniraptorans – the adult is particularly reminiscent of a large gallinaceous bird, like a turkey – is accurately portrayed here.

• Risograph print | 2017



DAWN WING
One of the oldest-known bats, *Onychonycteris* is from the Eocene Green River Formation. It had fully developed wings and was clearly a flyer. However, its proportions and anatomical details were very different from those of modern bats. All five of its fingers were clawed, for example (in modern bats, only two or three fingers are clawed). The insect it pursues is unidentified but was based specifically on a fossil recovered in the same rocks.

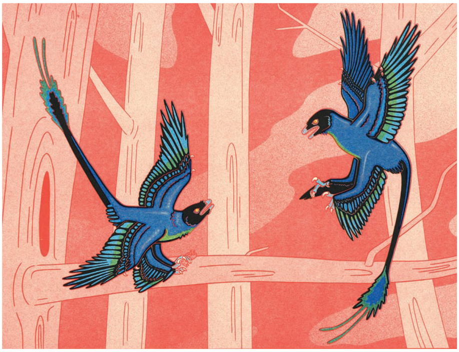
- **Risograph print | 2019**



THE ALBINO

Colour mutations are a passion of Greer’s and they wanted to see how the famous theropod *Velociraptor* would look if portrayed as completely white. Recent studies indicate that dinosaurs like this were not specialist tree-dwellers or climbers. Nevertheless, they could probably still climb when the need arose.

• Risograph print | 2019



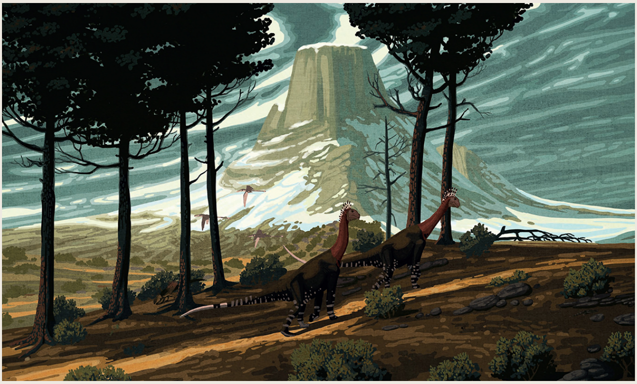
THE SQUABBLE

The inspiration for this scene was old natural science illustrations, where the animal is shown full colour but the background is etched in either black or sepia. To contrast with the black-and-blue *Microraptor* pair, red was used instead for the monotone backdrop. Studies of *Microraptor* fossils using electron microscopy have revealed colour pigments or melanosomes that suggest the animal was indeed a glossy iridescent black.

- **Risograph print | 2021**

AUSTRALIA

JOHN CONWAY

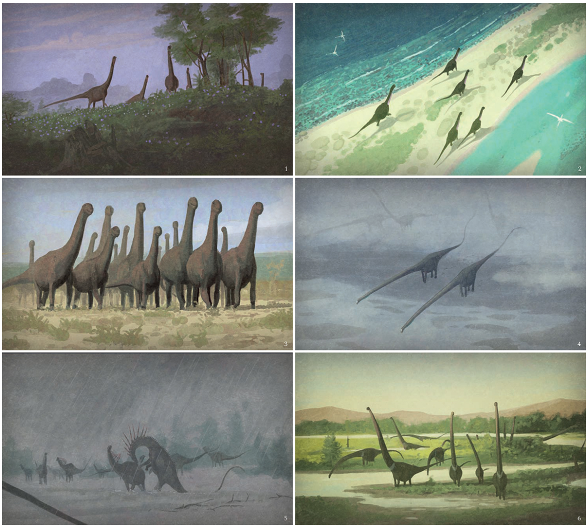


VULCANODON

A pair of the Early Jurassic South African sauropod *Vulcanodon karibaensis* walk beneath a strangely familiar mountain. *Vulcanodon* was anatomically archaic relative to more familiar sauropods and might have looked less ‘pillar-legged’ than later forms. The colours and composition of this painting were inspired by the cover of *Felt Mountain*, a 2000 album by English band Goldfrapp.

• Digital | 2020

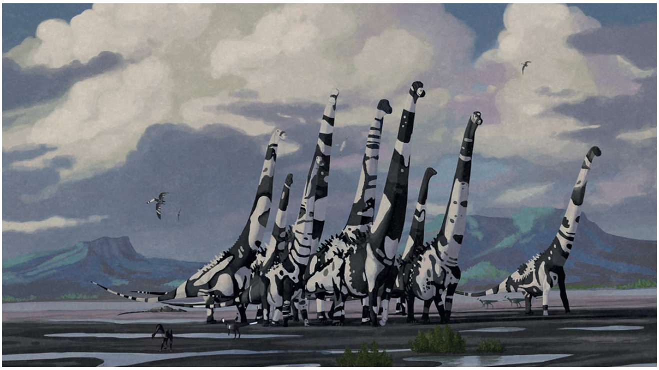
JOHN PRODUCES, in his own words, art ‘both *new* and *good*’: ‘new’, in the sense that he seeks to expand what might be defined as ‘Fine Art’ by exploring subjects generally outside that particular field, including dinosaurs and other ancient animals; ‘good’ in that he has a solid scientific understanding combined with a bold, bright approach to his subject matter. His varied styles make him one of the most influential artists in the field of palaeoart, perhaps best exemplified by his work on the acclaimed *All Yesterdays*: his collaboration with writer Darren Naish and fellow artist C. M. Kösemen, which takes a very unconventional view on the appearance and lives of dinosaurs and other prehistoric animals. John currently resides in London, UK.



SAUROPOD HERDS

As uniquely giant animals, sauropods may well have looked more like ‘features of the landscape’ than any other animal, but this stereotype would not have applied to all. Some were *only* as big as elephants or rhinos, and some had unusual body shapes that would have made them stand out relative to their surroundings. The species depicted here are: 1) *Alamosaurus sanjuanensis*; 2) *Europasaurus holgeri*; 3) *Camarasaurus lentus*; 4) *Barosaurus lentus*; 5) *Amargasaurus cazaui*; and 6) *Mamenchisaurus hochuanensis*.

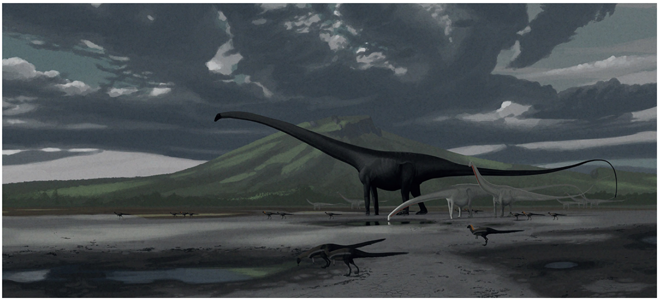
- **Digital | 2013**



DREADNOUGHTS

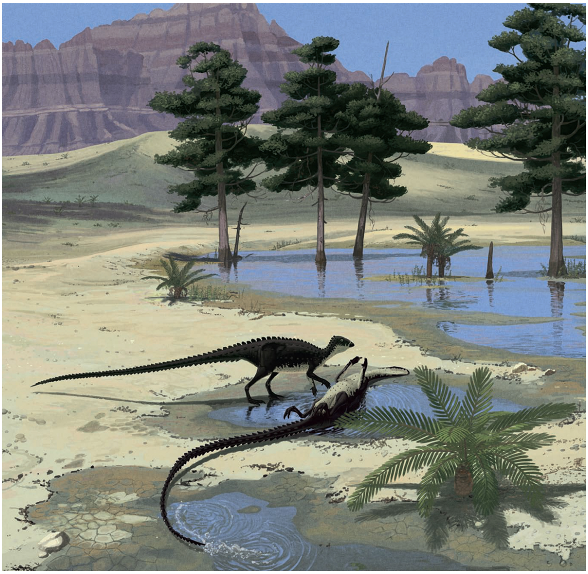
Giant sauropods may well have been essentially invulnerable to predation from even the biggest theropods, but small ones were not. What if 'dazzle camouflage' helped smaller animals hide within the mass of a herd? The colours on this giant Argentinian Late Cretaceous titanosaur *Dreadnoughtus schrani* is inspired by the work of Norman Wilkinson on dazzle-painted ships of WWI. Assorted other dinosaurs and large pterosaurs help provide scale for the sauropods.

- **Digital | 2020**



BAROSAURUS*, *DIPLODOCUS* AND *DRYOSAURUS
Fragmentary remains suggest that even familiar sauropods could reach sizes far exceeding those of well-known specimens. This moody scene conveys the size of an exceptionally large specimen – perhaps 45m long – of the Late Jurassic North American diplodocoid *Barosaurus*, ordinarily regarded as being similar in size to *Diplodocus* at around 20m in length. The two 'normal sized' *Diplodocus* present give an idea of what was possible. The scale of dinosaurs is artistically of extreme interest, but – John notes – a fact we mostly pretend not to be interested in as we become more serious about the artwork.

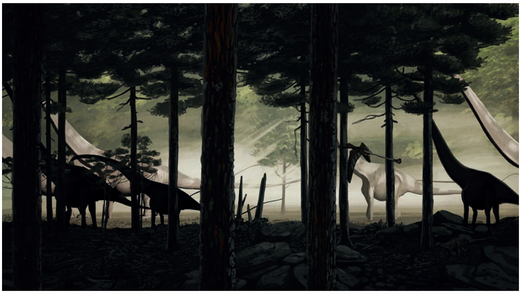
• Digital | 2017



THE PROMISED LAND

Discovered in the Early Jurassic of Arizona, *Scutellosaurus lawleri* is a long-tailed early member of the Thyreophora, the armoured group that includes ankylosaurs and stegosaurs. *Scutellosaurus* is depicted here as an animal of the desert (or, perhaps, desert edge), on this occasion apparently happy to have discovered some temporary (and rapidly evaporating) water.

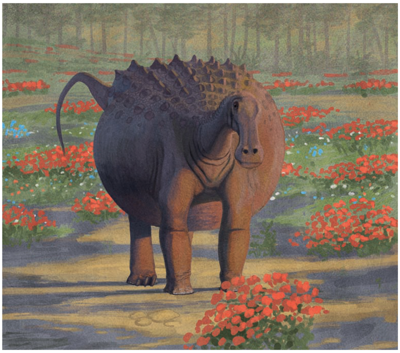
• Digital | 2014



UNCOMPOSITION: *SUPERSAURUS*

Part of a series in which John deliberately avoided posing and placing the animals ‘properly’ within the composition. Animals are ordinarily placed in a ‘maximally aesthetic’ position within an environment and positioned such that we can see the head and eyes. In completing this depiction of the Late Jurassic diplodocoid sauropod *Supersaurus*, John closed his eyes and selected the segment we see at random. However, the segment is part of a larger whole in which the animals were placed more ‘conventionally’. Further experimentation is required.

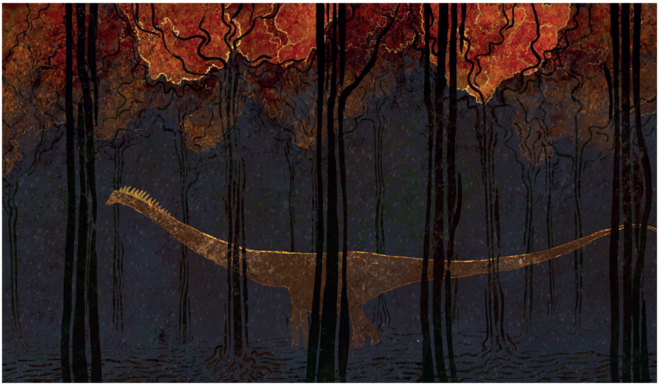
• Digital | 2022



SALTAPOTAMUS

We might think of sauropods as familiar, but they house more diversity and variation than is usually appreciated, while certain species are pretty odd. Some – the South American Late Cretaceous titanosaurs in particular – had extraordinarily wide hips. As such, could the likes of *Saltasaurus loricatus* have been a veritable 'hippo' of a sauropod? If so, what might this mean for its behaviour and biology?

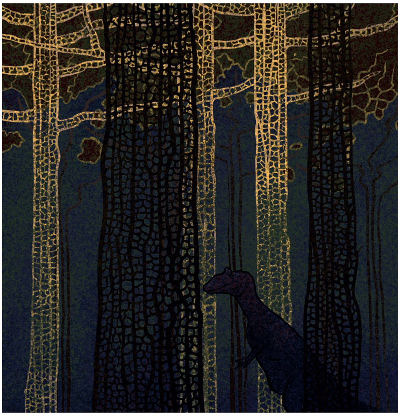
• Digital | 2020



ARRANGEMENT IN ORANGE AND *DIPLODOCUS*

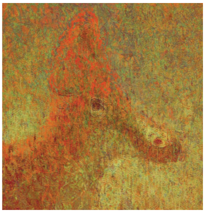
How far can an artist go before their artwork is no longer considered palaeoart? In this and the following pieces, John has experimented with a stylistic exploration of representing form using a sparse, cell-type structure and non-naturalistic colour. The names are based on the way James Abbott McNeill Whistler named his paintings.

- **Digital | 2019**



ARRANGEMENT IN BLUE AND *ALLOSAURUS*
This second ‘Arrangement in’ artwork depicts *Allosaurus* in a schematic forest. The argument has been made (by John himself, and by his colleague and co-author C. M. Kösemen) that we might seek to expand the boundaries of palaeoart in innovative, even counter-intuitive ways. Images of modern animals are treated this way on occasion; is there sufficient interest in similar experimentation when it comes to the animals of the past?

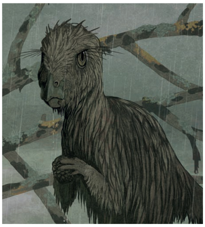
• Digital | 2019



OLOROTITAN ARHARENSIS

In another artistic experiment, John has sought to portray the Late Cretaceous Russian hadrosaur *Olorotitan* via an expressionist style where the image is formed of abundant small dots. The dinosaur is there, but its blurry, indistinct form runs counter to everything we regard as typical for the genre.

- **Digital | 2018**



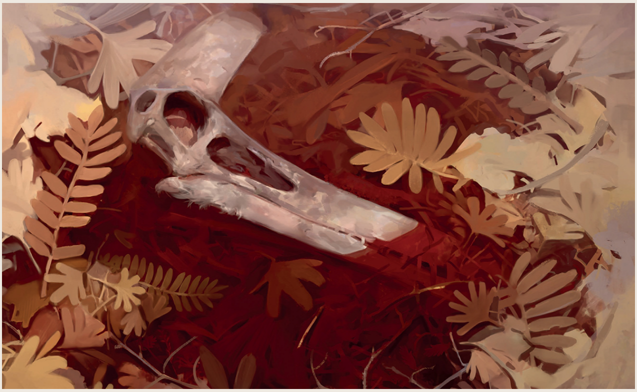
PORTRAIT OF *HYPSILOPHODON*

Some regions of the planet were extremely wet and extremely rainy during certain sections of Mesozoic time. We know essentially nothing of how dinosaurs dealt with regular ‘wetting events’. This image depicts the Early Cretaceous ornithopod *Hypsilophodon* looking wet and bedraggled. Its fuzzy pelage reflects discoveries made about small ornithischians from elsewhere in the world, some of which exhibit a covering of filaments.

• Digital | 2012

FINLAND

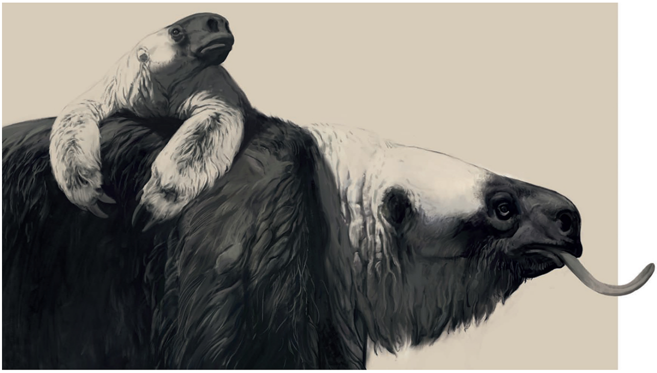
VILLE SINKKONEN



DEATH OF THE DRAGON
In a shallow pool filled with leaves and stained by tannin sits the skull of the Cretaceous Chinese pterosaur *Guidraco venator*. Colour, light and shadow are combined to create a melancholic scene – with an accurate palaeoflora – reflecting things as we might see them, were we to find the skull fresh in the Cretaceous.

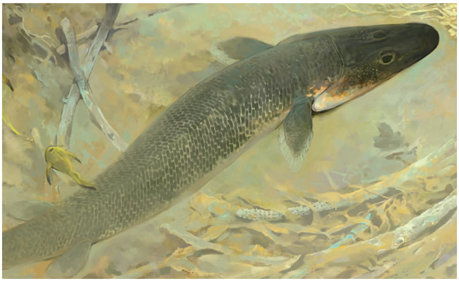
- Digital | 2019

VILLE LIVES IN HELSINKI, where he studied palaeontology at the city's university. A self-taught artist, he chose to trade academia for a career in art, subsequently producing illustrations for the Natural History Museum in Helsinki and the Heureka Science Centre. He now works full-time as a professional palaeoartist, concept designer and illustrator.



HARLAN'S GROUND SLOTH *PARAMYLODON HARLANI*
Paramylodon is famously associated with the La Brea tar pits. The prehensile tongue, bulbous form of the nose and variegated colour pattern all reflect artistic decisions made after appropriate research. It remains unknown whether ground sloths carried their babies on their backs in the manner shown here, but the existence of this behaviour in modern xenarthrans doesn't preclude it.

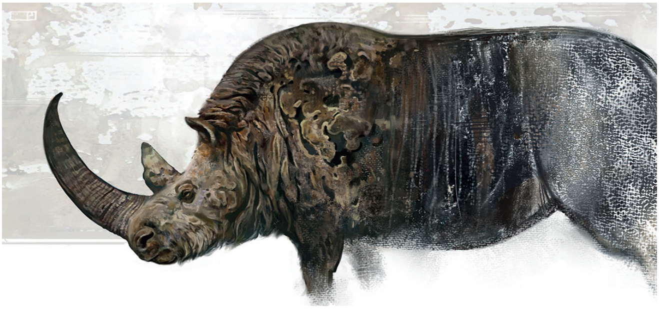
• Digital | 2019



ELPISTOSTEGE WATSONI* AND *BOTHRIOLEPIS CANADENSIS

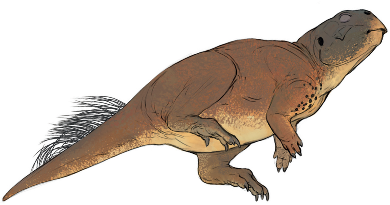
A Late Devonian pond in Canada. The larger animal – *Elpistostege* – is part of the elpistostegids, a group that includes the ancestors of the tetrapods. *Bothriolepis* is an antiarch placoderm widespread in the Devonian. Known from numerous species, it was remarkable for several reasons, including pectoral fins modified into jointed appendages superficially recalling arthropod limbs.

• Digital | 2019



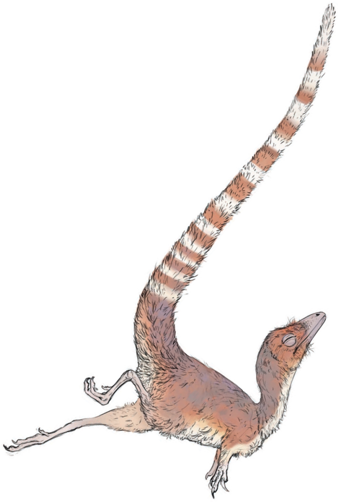
THE WOOLLY RHINO *COELODONTA ANTIQUITATIS*
A huge amount is known about the life appearance of the Woolly Rhinoceros thanks to both exceptionally preserved specimens (with skin, fur and intact horns) and to cave art. This image references the idea (reflected in cave art) that some Woolly Rhinos had a vertical black band across the middle of the body. The massive shoulder-hump and mottled texture of the enormous anterior horn are also in evidence.

• Digital | 2019



***PSITTACOSAURUS* SP.**
Thanks to one Chinese specimen in particular, we now know that the Early Cretaceous ceratopsian *Psittacosaurus* was – at least on occasion – 'plump' in appearance and possessed hair-like quills on its tail and black speckles on its forelimbs. This is one of several of Ville's pieces showing specific Early Cretaceous Chinese dinosaur specimens as they might have looked when freshly deceased.

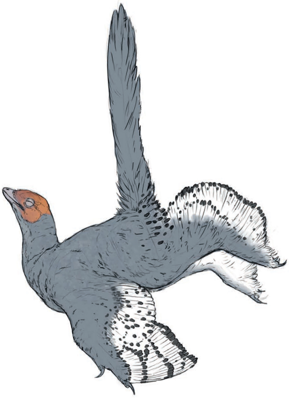
• Digital | 2017



SINOSAUROPTERYX PRIMA

Sinosauropteryx – a compsognathid coelurosaur – became famous in 1996 for being the first non-bird dinosaur to preserve evidence of feathers; more recent work has enabled experts to make conclusions about the colour of its feathers. The pose reflects how the animal was found in its fossilised state.

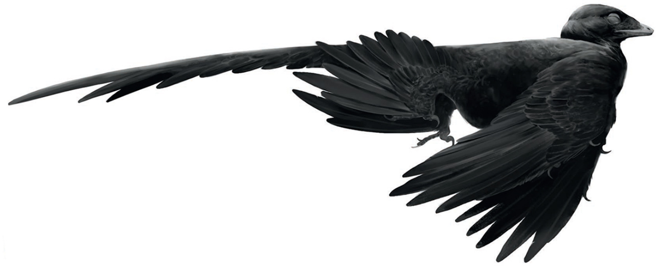
- **Digital | 2017**



ANCHIORNIS HUXLEYI

Anchiornis is a substantially more bird-like animal than *Sinosauropteryx*, something obvious from the numerous large, complex feathers on its forelimbs as well as its hindlimbs. Again, the pose mimics that of a specific fossil individual.

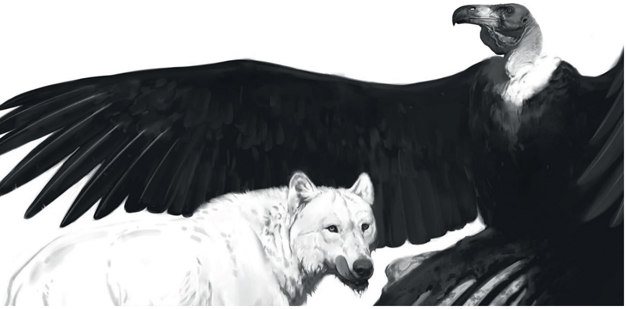
Digital | 2017



MICRORAPTOR ZHAOIANUS

This final piece in the ‘recently deceased’ series depicts the famous small dromaeosaurid *Microraptor*. The ‘birdiness’ of its shape and details is obvious. Microscopic pigment particles on its feathers show that *Microraptor* was black and iridescent (or, at least, some individuals were), suggesting that it was superficially crow-like when alive.

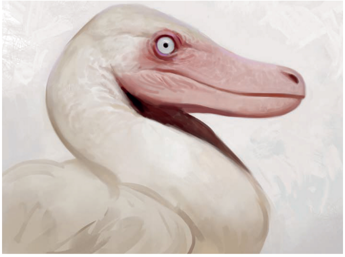
• Digital | 2017



DIRE WOLF *AENOCYON DIRUS* AND TERATORN *TERATORNIS MERRIAMI*

The 2021 discovery that dire wolves might not be close kin of *Canis* species invites speculation on what they really looked like in life. Teratorns – a group of raptors related to modern condors – also need revision. Often depicted as condor-like, they might have been very different.

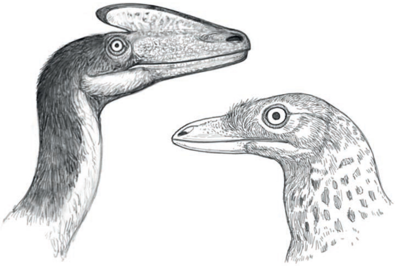
- **Digital | 2019**



TSAAGAN MANGAS

It is now *de rigueur* among palaeoartists to depict dromaeosaurids as mottled, hawk-or pheasant-like predators, but other possibilities do exist. Perhaps inspired by the etymology of its name (which means ‘white monster’), Ville has depicted *Tsaagan* with a pale pelage.

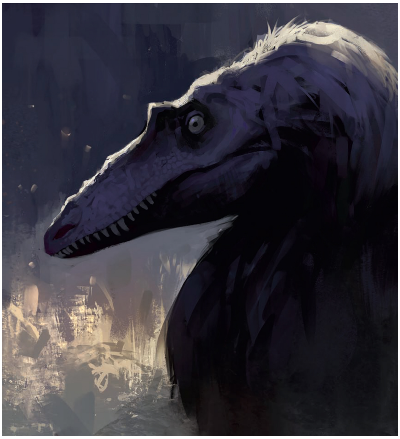
• Digital | 2016



GUANLONG WUCAII AND _SINORNITHOSAURUS_ SP. 'DAVE'

Head studies of the archaic Jurassic tyrannosauroid *Guanlong* and the Early Cretaceous dromaeosaurid *Sinornithosaurus* highlight the similarities and differences between the members of these distantly related lineages. Dromaeosaurids were substantially more bird-like than even the smallest and most feathery of tyrannosauroids.

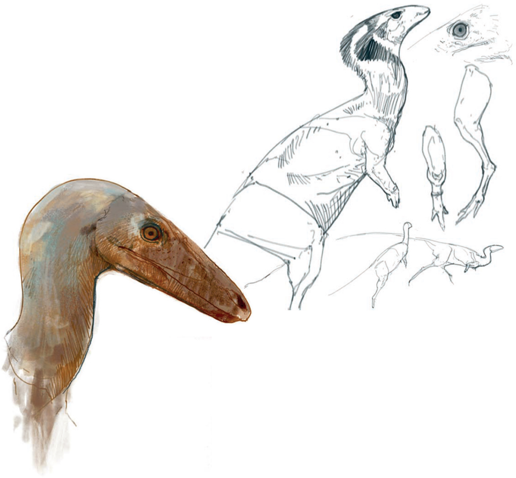
• Digital | 2021



QIANZHOUSAURUS SINENSIS

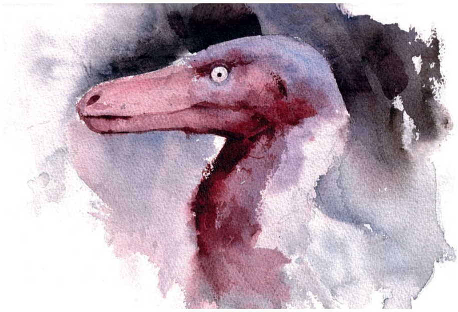
Shown here looking rather sinister, *Qianzhousaurus* from the Late Cretaceous of China – now forever memorialised as 'Pinocchio rex' – has fast become one of the most frequently depicted of Cretaceous theropods. It was a spectacular and fascinating animal, so this is not unjust.

- **Digital | 2014**



THEROPOD AND ORNITHOPOD SKETCHES
The fact that small theropods (above) and bipedal ornithopods (right) are superficially similar in shape raises all kinds of possibilities for the biology and appearance of these animals.

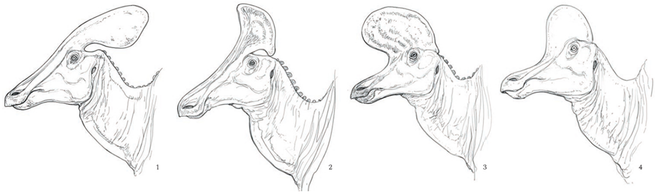
• Digital | 2018



VELOCIRAPTOR MONGOLIENSIS

There is no indication that the digital revolution has 'killed' traditional media. Software like Photoshop is just another tool, and the basics needed in art are no different to how they were in previous decades (or centuries). Some artists, Ville included, also like to return to the 'feel' of traditional media now and then, as in this watercolour.

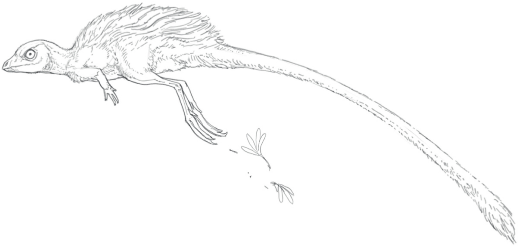
- **Watercolours | 2015**



1) *TLATOLOPHUS GALORUM*
2) *OLOROTITAN ARHARENSIS*
3) *LAMBEOSAURUS MAGNICRISTATUS*
4) *CORYTHOSAURUS CASUARIUS*

The implication that crested hadrosaurs were all very much the same apart from their head crests has never been true. In fact, variation in facial proportions, beak shape and neck length, among other features, means that these animals were highly distinct when alive, doubtless with divergent ecologies and behaviours.

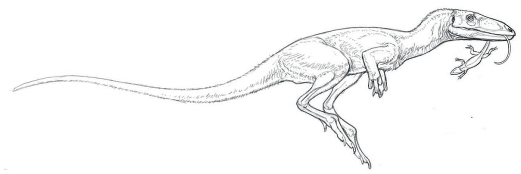
• Digital | 2021



TIANYULONG CONFUCIUSI

Proof that ornithischians could be fuzzy too arrived in 2009 in the form of *Tianyulong*, a Jurassic heterodontosaurid from China. Long, hair-like filaments grow from its back, tail and other parts of the body. This reconstruction also borrows from an as-yet unpublished specimen that reveals an extravagant tail likened by some to that of a marmoset.

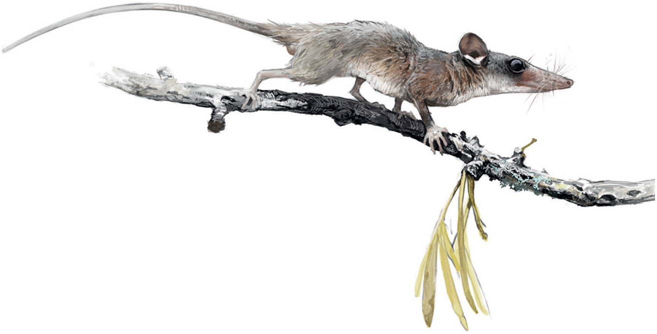
• Digital | 2021



DILONG PARADOXUS

Dilong was a small Early Cretaceous tyrannosauroid whose discovery confirmed that early members of this group were fuzzy-coated. Like many small and mid-sized theropods, its lack of anatomical specialisations suggests life as a generalist predator.

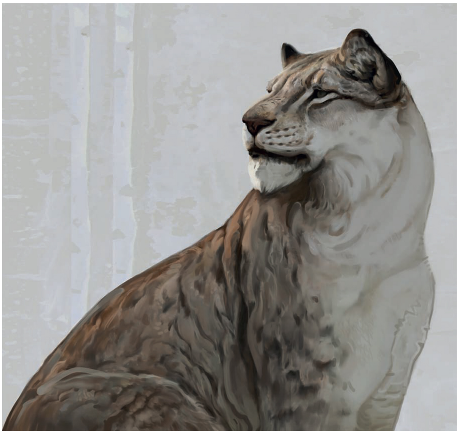
- **Digital | 2021**



JURAMAIA SINENSIS

The old adage that Mesozoic mammals were all ‘shrews’ was never true. However, many mammals of the Jurassic and Cretaceous were small, burrowing insectivores. *Juramaia*, from the Late Jurassic of China, was tiny, close to the origin of placental mammals, and with finger proportions and other features indicative of a climbing ability.

• Digital | 2019



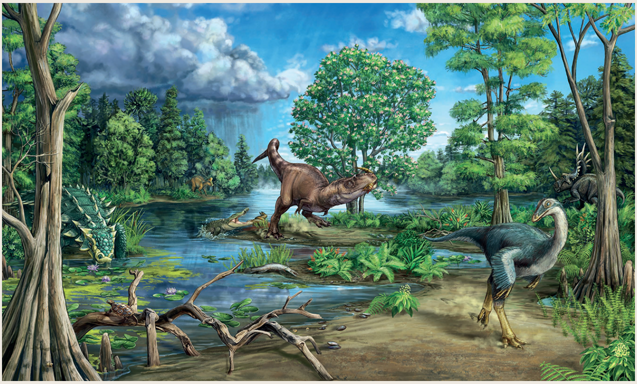
***HOMOTHERIUM* S P.**

The great cats of the geological past were surely every bit as beautiful and spectacular as their living relatives. *Homotherium* was a large and relatively long-faced sabretooth, species of which occurred on most continents during the Pliocene and Pleistocene.

• Digital | 2019

CANADA

DANIELLE DUFAULT



ZUUL'S WORLD

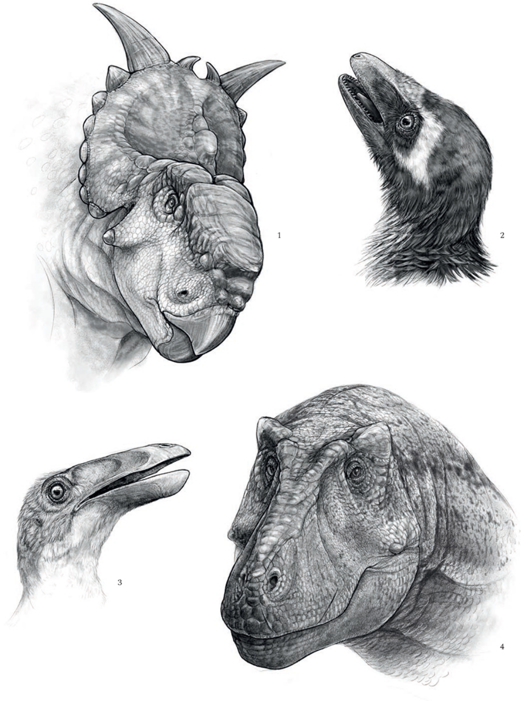
Produced to accompany an exhibition on the Judith River Formation ankylosaurid *Zuul*, this scene depicts various of *Zuul*'s contemporaries, including the theropods *Gorgosaurus libratus* (centre) and *Ornithomimus edmontonicus* (foreground, right); the hadrosaur *Lambeosaurus lambei* (centre left) and ceratopsian *Styracosaurus albertensis* (upper right); the crocodyliform *Leidyosuchus canadensis*; and the turtle *Plesiobaena antiquus*. The flora includes *Metasequoia*, the laurel *Ficus planicosta* and the water lily *Nelumbo.*

- **Digital | 2018**

DANIELLE DUFAULT is a scientific illustrator from Toronto, and an in-house palaeoartist and research assistant at the Royal Ontario Museum (ROM). Her work is the result of a long-standing fascination with the natural world and an unyielding desire to understand it. She is a graduate from the Technical and Scientific Illustration degree program at

Sheridan College. Using both traditional and digital techniques, she works closely with researchers to create art and scientific diagrams for everything from anatomical charts to exhibition murals. She has participated in many dinosaur digs with the ROM Palaeontology team; her greatest find to date has been a *Triceratops* skull in Montana's Hell Creek Formation. Her work has been published in many scientific journals and has been used to illustrate newly named prehistoric species. She is also the host of *Animalogic*, a YouTube channel on zoology and biodiversity. When not digging into the past, Danielle creates educational and artistic content about animals, shooting on location across the world from Tasmania to Costa Rica. Learning about and observing extant wildlife informs and gives fresh perspective to her insights on extinct animals and ecosystems.

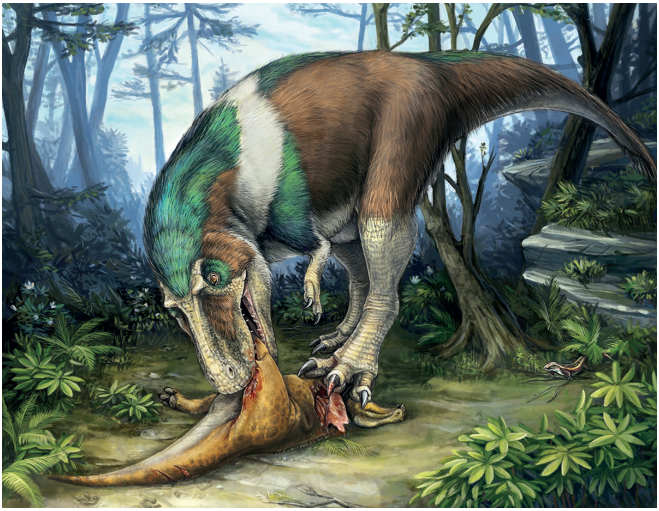
All images used courtesy of the Royal Ontario Museum.



ALBERTAN DINOSAUR PORTRAITS

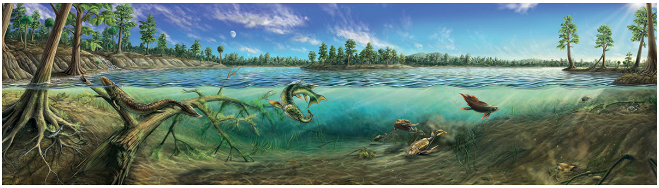
A selection of Late Cretaceous dinosaurs, all known from the fossil record of Alberta. The species depicted here are: 1) the great centrosaurine horned dinosaur *Pachyrhinosaurus canadensis*, famed for its thickened nasal boss; 2) *Albertavenator curriei*, a small troodontid theropod currently known only from the top of its skull; 3) the ostrich dinosaur *Struthiomimus altus*; and 4) *Tyrannosaurus rex*.

• Digital | 2018



DINNER IN DINOSAUR PARK
The tyrannosaurid *Gorgosaurus libratus* consumes a *Corythosaurus casuarius*. *Gorgosaurus* is predominantly associated with the Dinosaur Park Formation of Alberta, and confusion with the closely related *Albertosaurus* and more distantly related *Daspletosaurus* has long hindered understanding of its anatomy. Current evidence leans toward a mostly scaly body covering in tyrannosaurids.

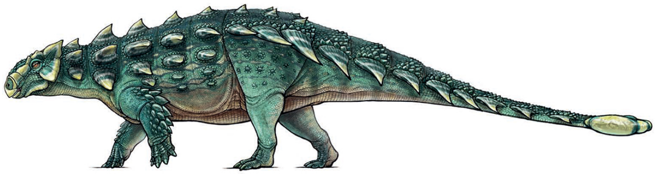
• Digital | 2015

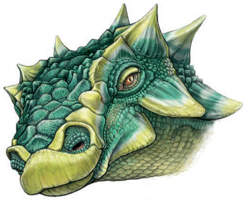


DAWN OF LIFE: DEVONIAN MIGUASHA

The incredible diversity of Devonian fossil fish at Miguasha National Park, Quebec, led to its designation as a World Heritage Site in 1999. This scene includes: (far left) the acanthodian *Triazeugacanthus affinis*; at the water's edge is *Elpistostege watsoni* – an animal close to the ancestors of tetrapods. Sarcopterygian fish include: (centre right) the deep-bodied lungfish *Scaumenacia curta* and (centre) the large, predatory *Eusthenopteron foordi* eating the archaic ray-finned fish *Cheirolepis canadensis*. The armour-plated placoderm *Bothriolepis canadensis* and the (far right) osteostracan *Levesquaspis patteni* are on the lakebed. Also included are the small crustacean *Asmusia* and giant eurypterid *Pterygotus*. Plants include *Archaeopteris*, *Calamophyton*, *Protobarinophyton* and *Aneurophyton*.

• Digital | 2021

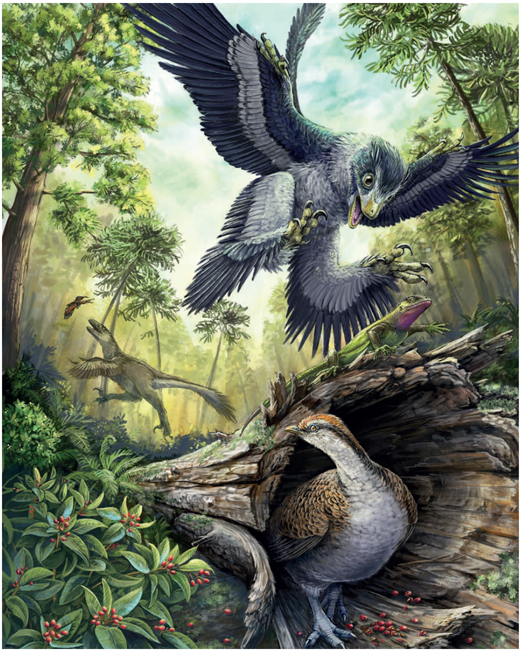




ZUUL, DESTROYER OF SHINS

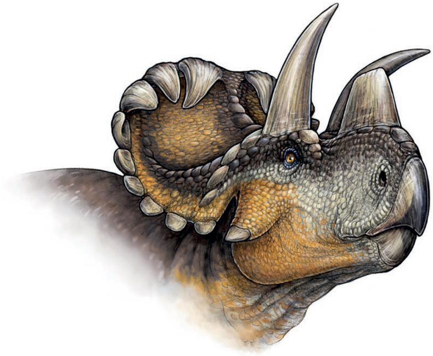
Zuul crurivastator is a remarkably spiky ankylosaurid described in 2017 from a specimen found in Montana and noted for its well-preserved skull and tail. In contrast to some related ankylosaurids, prominent triangular osteoderms projected sideways from the sides of its tail, hence the species name ‘*crurivastator*’, meaning ‘destroyer of shins’. This refers to their possible offensive use against large theropods.

• Digital | 2018



HELL CREEK'S UNDERDOGS
Small predatory theropods from the Hell Creek fauna of latest Cretaceous western North America included dromaeosaurids like *Acheroraptor* (background, chasing an enantiornithine bird), and microraptorines (seen ambushing a lizard). Also present were early members of the crown-bird clade. These superficially grouse-like animals were omnivores or herbivores that could subsist for a time on seeds alone. Non-bird theropods did not survive the impending K–Pg extinction event, but crown-birds did.

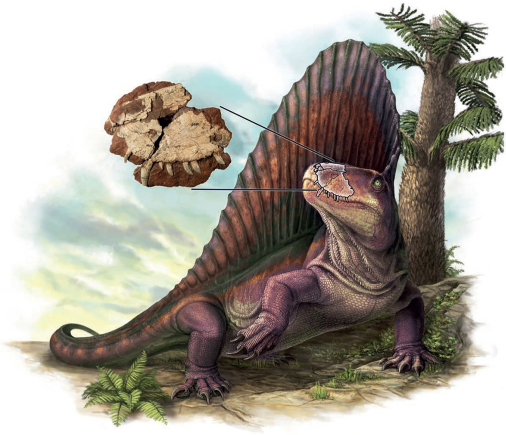
• Digital | 2016



WENDICERATOPS PINHORNENSIS

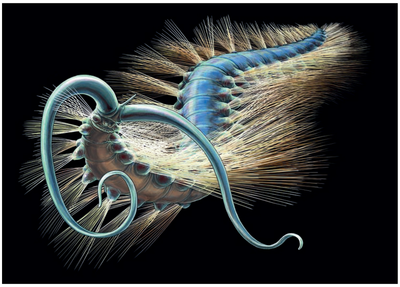
Wendiceratops is a centrosaurine from the Upper Cretaceous Oldman Formation of Canada, named after its finder – fossil hunter Wendy Sloboda – in 2015. This illustration was produced to accompany its formal description. The squared-off nasal horn is distinctive, as are the down-turned structures (the epiparietals) fringing the upper margin of the frill. Centrosaurines mostly lack supraorbital horns, but *Wendiceratops* is one of a growing number of early-diverging members of the group that had these.

• Digital | 2015



THE PERMIAN ICON
Dimetrodon is one of the most familiar prehistoric animals of all, and frequently considered a 'default dinosaur' by the uninitiated. *Dimetrodon* was a diverse genus containing more than 10 species. This reconstruction depicts *D. borealis* of Prince Edward Island, Canada – a species known only from a maxillary bone and accompanying teeth. Initially described in 1854, it was misidentified as a dinosaur and named *Bathygnathus*, meaning 'deep jaw'.

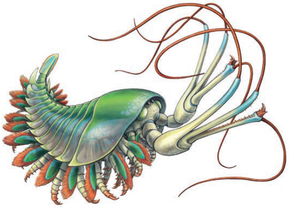
• Digital | 2015



KOOTENAYSCOLEX BARBARENSIS

A bizarre animal named in 2018, *Kootenayscolex* is an aquatic worm from the famous Cambrian-aged Burgess Shale of British Columbia. It is known from more than 500 individuals, most less than 3cm long. Hundreds of bristles projected from its sides and probably played a role in locomotion. Their distribution on the animal caused experts to revise their views on the evolution of the relevant group: the bristle worms, or polychaetes.

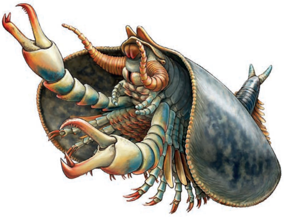
- **Digital | 2018**



YAWUNIK KOOTENAYI

An armour-plated swimming crustacean from the Burgess Shale, *Yawunik* was described in 2015. Its generic name is borrowed from a sea monster in the culture of the indigenous Ktunaxa. About 10cm long, *Yawunik* bore a pair of flexible 'great appendages' that were lined with fine teeth for part of their lengths and tipped with whip-like 'flagellate rami'.

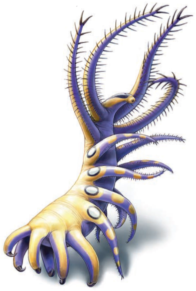
- **Digital | 2015**



TOKUMMIA KATALEPSIS

Tokummia, named in 2017, is a Burgess Shale arthropod with distinct mouthparts and prominent pincers – the oldest yet known in the fossil record. A two-part shell covered its 10cm-long body. *Tokummia*'s various features suggest it was closely related to the Mandibulata, the arthropod group that includes crustaceans and insects.

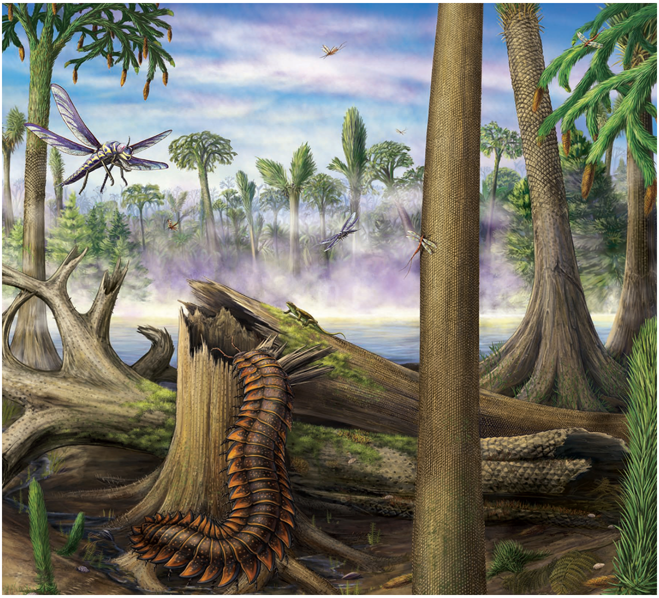
- **Digital | 2017**



OVATIOVERMIS CRIBRATUS

A Burgess Shale animal named in 2017, *Ovatiovermis* is a 3cm-long lobopodian – a mostly Cambrian group of soft-bodied animals with blunt legs termed lobopods. They are archaic members of the arthropod lineage. The spine-covered anterior lobopods of *Ovatiovermis* suggest a suspension-feeding lifestyle that involved standing at elevated locations and waving its lobopods in the current. Many lobopodians have a disturbing appearance.

• Digital | 2016



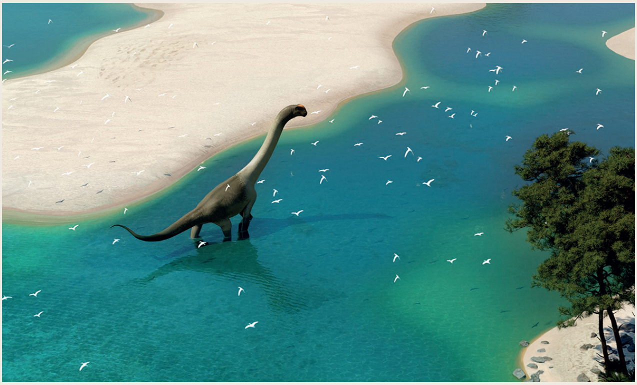
CARBONIFEROUS JOGGINS

This scene depicts life at Joggins, Nova Scotia, during the Carboniferous, around 310 million years ago. The most famous discovery there was the lizard-like early reptile *Hylonomus lyelli* (centre, on a tree trunk). Also present were the griffinfly *Meganeura*; the stupendous millipede *Arthropleura*; and members of the winged insect group Megasecoptera. Plants include the gigantic ‘scale trees’ *Sigillaria* and *Lepidodendron*.

• Digital | 2021

BRAZIL

JULIO LACERDA



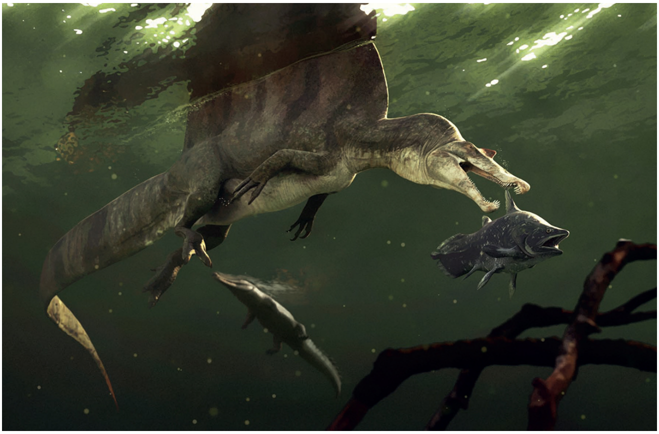
***EUROPASAURUS* AND PTEROSAURS**

Europasaurus – which really must win the award as the least imaginatively named dinosaur of the twenty-first century (sorry, scientific describers) – inhabited an island archipelago in what is now Germany during the Late Jurassic, around 155 million years ago. It was a dwarf, island-dwelling sauropod, only the size of a large cow or small elephant.

- **Digital | 2021**

JULIO BEGAN PRODUCING palaeoart around ten years ago, purely as a hobby after finding out there was a community of people dedicated to this area on social media. Spurred on, he left his job as a graphic designer and photo editor six years ago to become a full-time freelance palaeoartist. As well as a series of books published in Brazil, he has provided pterosaur illustrations for Japan's Fukui Prefectural Dinosaur Museum and Oregon's ScienceWorks

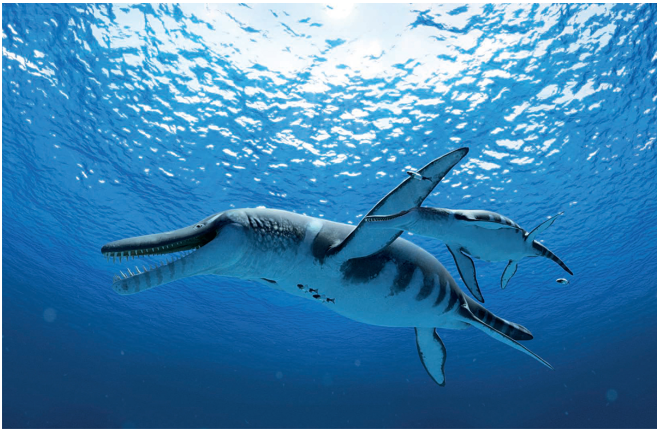
Hands-On Museum. He also worked with the North Carolina Museum of Natural Sciences for their 2013 announcement of the discovery of the theropod *Siats meekerorum* and was responsible for several murals and graphics for the *Fossils Uncovered* exhibit in Seattle's Burke Museum of Natural History and Culture. He currently contributes regularly to PBS's *Eons* YouTube channel, producing illustrations for their educational videos.



SPINOSAURUS, MAWSONIA, ELOSUCHUS

Even prior to the most recent discoveries made about *Spinosaurus*, it was traditional to show it in the delta and swamp environments that covered its North African home during the Late Cretaceous. The deep, laterally compressed tail shown here takes account of research published in 2020. This piece is also in line with claims that it was an active, swimming predator. Giant fish like the big coelacanth *Mawsonia* and crocs like *Elosuchus* lived alongside *Spinosaurus*.

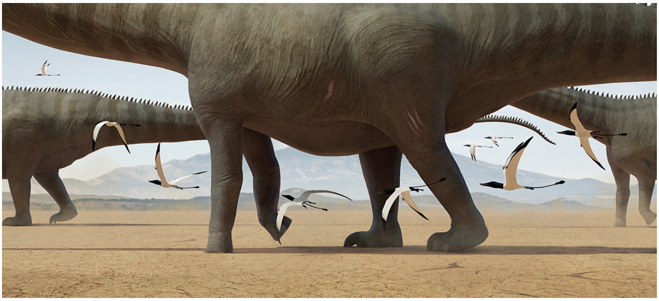
• Digital | 2020



KRONOSAURUS

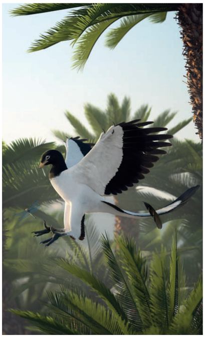
Mesozoic marine reptiles remain incredibly fertile subjects for palaeoart. Here, we see the Cretaceous pliosaurid *Kronosaurus*, specimens of which reached around 10m in length. The association of an adult with a juvenile suggests parental care. This is not idle speculation but a nod to the recent discovery of a pregnant pliosaur, preserved with a proportionally enormous baby within her body. The baby is so large that parental care very probably occurred.

- **Digital | 2020**



DIPLODOCUS, RHAMPHORHYNCHOID PTEROSAURS
If you were observing living sauropods at close range (this is the Late Jurassic *Diplodocus*), it is unlikely you'd be able to view the whole animal. Nevertheless, you could appreciate noteworthy features such as the remarkable and unique feet, the triangular dermal spines (known so far from just one species, but quite possibly widespread within the group) and the presence of a hyper-detailed scaly skin surface – bane of the palaeoartist! The wounds and damaged spines here hint at interesting life experiences.

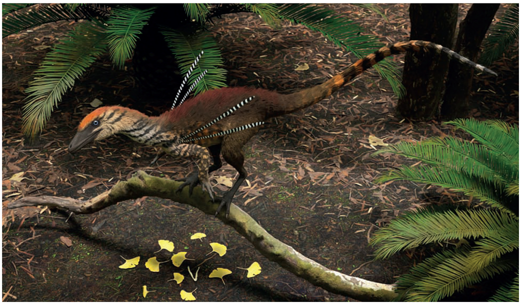
• Digital | 2020



ARCHAEOPTERYX

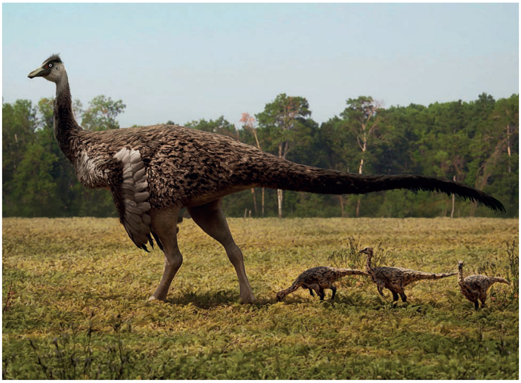
For all our many discoveries of remarkable feathered maniraptorans in China, the German *Archaeopteryx* remains an iconic Jurassic maniraptoran, tied closely in some way to bird origins. Today, we also understand many specific details regarding its plumage and even its colour. Its facial shape, foot proportions and wing and tail shape can also be portrayed in minute detail.

• Digital | 2021



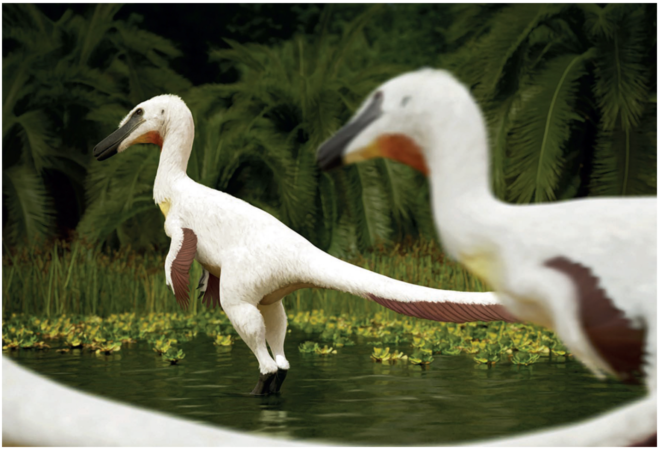
'UBIRAJARA'
This Brazilian theropod is currently without an official scientific name, since the publication naming it was withdrawn due to ethical concerns about the fossil's origins. It was equipped with four long structures that emerged from the shoulders, suggesting a role in mating display akin to those of elaborately ornamented birds today, such as birds-of-paradise or manakins. The animal has created a clearing and collected attractive ginkgo leaves as decoration.

• Digital | 2021



ORNITHOMIMUS
The once-popular idea that ostrich dinosaurs ‘looked like ostriches but without the feathers’ looks quaint and naïve today. Actually, ostrich dinosaurs – this is the North American *Ornithomimus* – were not really as ‘ostrich-like’ as initially thought. Their head shape is different, their hindlimbs more robust, and the massive tail creates a very different profile. Evidence for parental care comes from groups where juveniles and adults are preserved together.

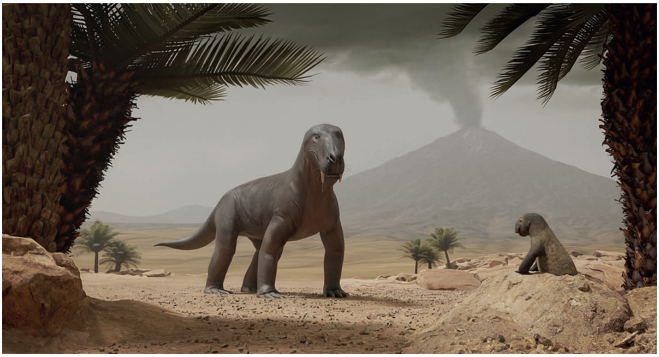
• Digital | 2020



AUSTRORAPTOR

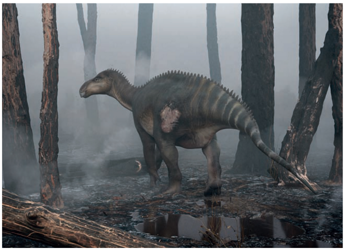
The discovery of the giant, spinosaur-like unenlagiine *Austroraptor* in Argentina was something of a revelation. Named in 2008 it is – at around 6m in length – an especially big member of a group whose other species were mostly 2–3m long. Like spinosaurs, it is plausible that *Austroraptor* was not necessarily a fish specialist but consumed a broad range of other prey.

- **Digital | 2020**



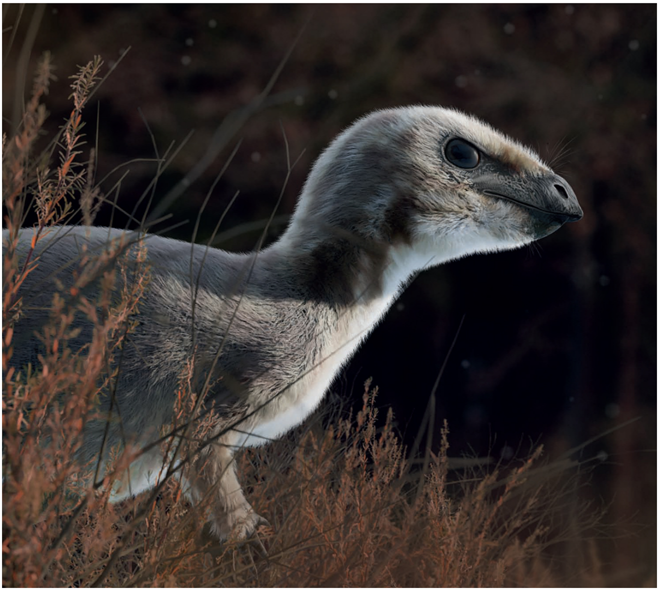
***INOSTRANCEVIA, DIICTODON*-LIKE DICYNODONT**
The world of the Permian would have seemed quite alien to us. The sabre-toothed Russian gorgonopsian *Inostrancevia* (left) was a large therapsid, reaching 3.5m in length and with a skull up to 60cm long. Skull anatomy indicates that these big gorgons were powerful predators able to dispatch the biggest herbivores of the time. However, small prey items were probably also taken, such as small, burrow-dwelling dicynodonts.

- **Digital | 2020**



IGUANODON BERNISSARTENSIS
Evidence indicates that fires were frequent and widespread during the Cretaceous. Whilst usually associated with English fossils, the iconic ornithopod *Iguanodon* derives its species name (*bernissartensis*) from the famous bonebed found in a coal mine in Bernissart, Belgium.

- **Digital | 2021**



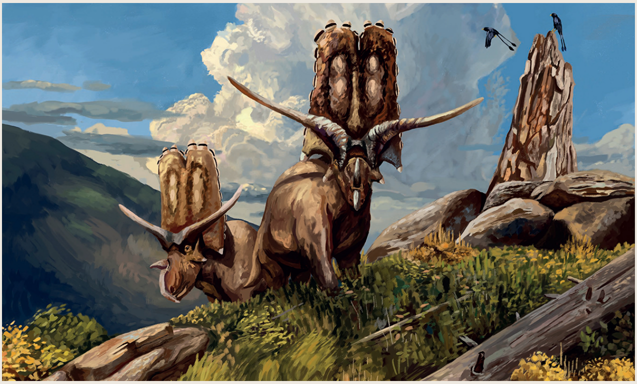
LEAELLYNASAURA

It would seem odd that small dinosaurs like *Leaellynasaura* from Early Cretaceous Australia would have inhabited cool, seasonally dark places without an insulating covering. However, recent discoveries indicate that such dinosaurs did actually have a pelt, like the one beautifully portrayed here. Interesting details include the shape of the pupil, the presence of whisker-like filaments and the nature and blending of the facial tissues and beak.

- **Digital | 2021**

USA

BRENNAN STOKKERMANS

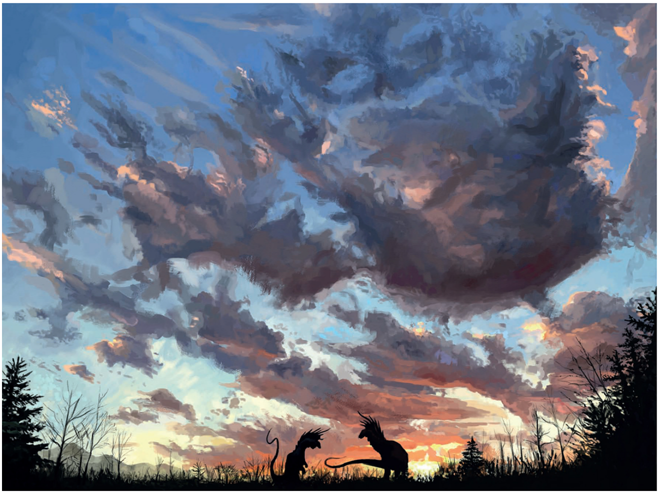


THE NOMADS

Terminocavus is a horned dinosaur from the Kirtland Formation of New Mexico, named in 2020 and – so far – known only from the upper part of its frill. It was clearly related to *Anchiceratops* and other long-frilled chasmosaurines, and the suggestion has been made that it was part of the same evolutionary lineage as *Pentaceratops*, perhaps even its descendant.

- **Digital | 2020**

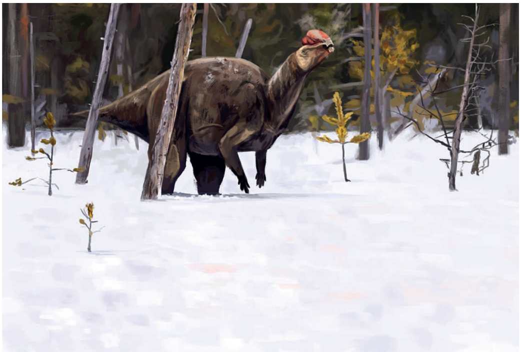
BRENNAN STOKKERMANS is a visual artist from Cleveland, Ohio, currently studying Biology and Art at Ohio State University. Brennan's career as a palaeoartist was triggered by drawing pencil studies during birdwatching trips. His discovery of the close relationship between birds and dinosaurs rekindled his childhood interest in dinosaurs. His art is inspired by his work as a photographer as well as an appreciation of western classical and impressionistic art. He feels that the creative freedom inherant to palaeoart has led him to be the artist he is today.



MOLTEN SKIES

Bajadasaurus from the Early Cretaceous of Argentina was described in 2019 and must be one of the strangest sauropods yet known. Long, slender, forward-curving bony spines projected from the top of its neck. Unfortunately it is currently known only from fragmentary remains, and much uncertainty remains about its exact appearance. Perhaps the spines were used in visual display or even in mating jousts.

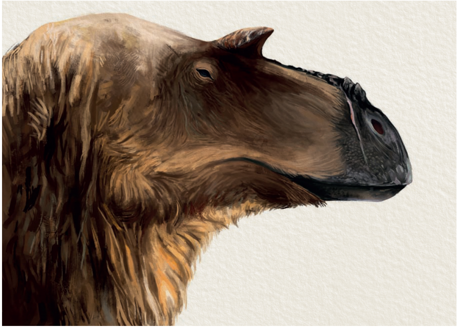
- **Digital | 2019**



WINTER MORNING

The Cretaceous north and south were both cool enough and – importantly – wet enough for snow to fall regularly in winter. Cretaceous southern Australia was close enough to the South Pole at the time to experience wintery conditions. Here, a lone bull *Muttaburrasaurus* – a large Australian ornithopod noted for its inflated bony snout – wakes to fresh snow.

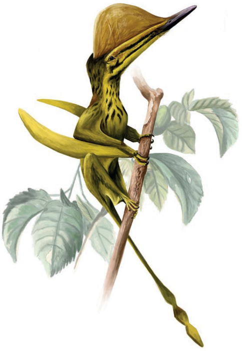
• Digital | 2022



WINTER MOULT

A young Early Cretaceous tyrannosauroid – *Yutyrannus* – undergoes its annual, post-winter moult and is not enjoying it. *Yutyrannus* demonstrates that at least some large dinosaurs – it was 10m long – possessed a fuzzy pelt, presumably as insulation in the cool environments they frequented. Invariably depicted as white or grey, there's no reason why *Yutyrannus* couldn't have been brown.

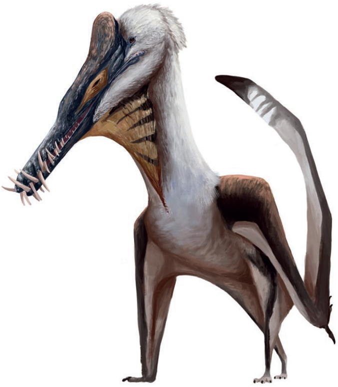
• Digital | 2020



KUNPENGOPTERUS

Kunpengopterus is a small, long-tailed Jurassic pterosaur from China. Some specimens have a mid-line bony crest on the skull, and soft tissue impressions show that this was enlarged in life by a skin or horn extension. One *Kunpengopterus* species appears unique among pterosaurs in that the first of its three clawed fingers opposed the other two, perhaps giving the animal an advantage in climbing and gripping plants.

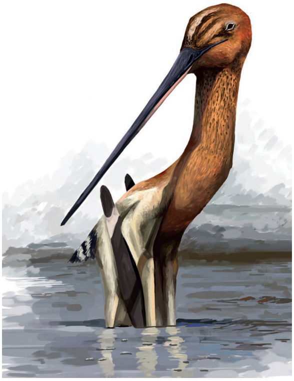
- **Digital | 2021**



HANSANDONG BOREOPTERID

The boreopterids are an odd and poorly known group of Cretaceous Asian pterodactyloid pterosaurs. Slender jaws and closely spaced, abundant, fang-like teeth and a rectangular crest are among their most distinctive features, but little is known of their biology. The animal depicted here is a currently unnamed species from South Korea, known only as the Hansandong boreopterid.

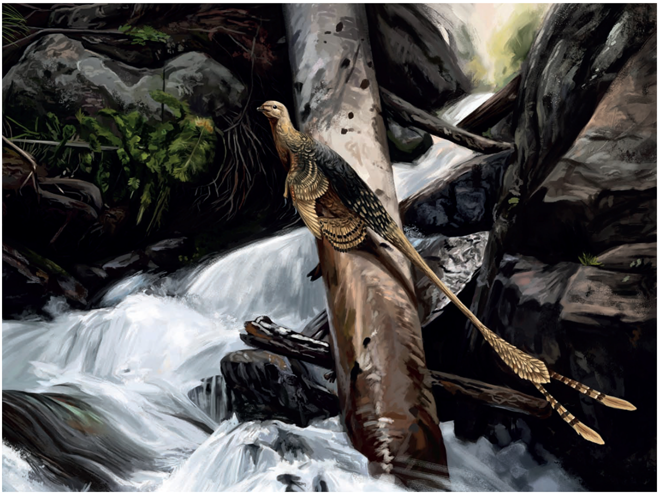
- **Digital | 2019**



LEPTOSTOMIA

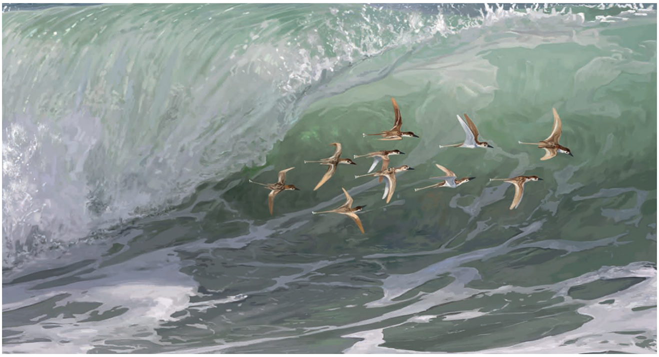
One of many pterosaurs named recently from the ‘middle’ Cretaceous Kem Kem rocks of Morocco, *Leptostomia* is a small and enigmatic animal known so far only from segments of its highly slender snout and jaws. These suggest that it was a prober that fed on worms and other sediment-dwelling invertebrate animals, a possibility very much alluded to here.

- **Digital | 2021**



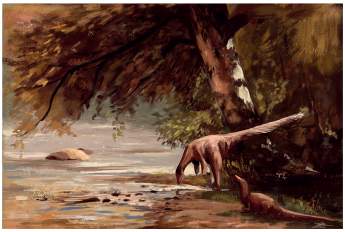
THE RAPIDS
Dinosaurs like the Early Cretaceous Chinese microraptorine *Wulong* – named in 2020 – have, quite frankly, blown us away with their spectacular, over-the-top plumage. Like most microraptorines, *Wulong* has long, impressive feathers on its legs and feet as well as its arms and hands, and it combines these with long tail feathers, the longest of which project from the tail tip. Some disagreement exists over whether these feathers had an aerodynamic role or a display one.

• Digital | 2021



SEAFOAM PASS
Arcticodactylus is a small, archaic pterosaur from the Late Triassic of Greenland, formerly included within *Eudimorphodon* until given its own name in 2015. It is one of the smallest pterosaurs known, with a wingspan of around 24cm. The single known *Arcticodactylus* individual comes from sediments deposited in a terrestrial setting but it remains entirely possible that this animal moved across coastal or marine environments.

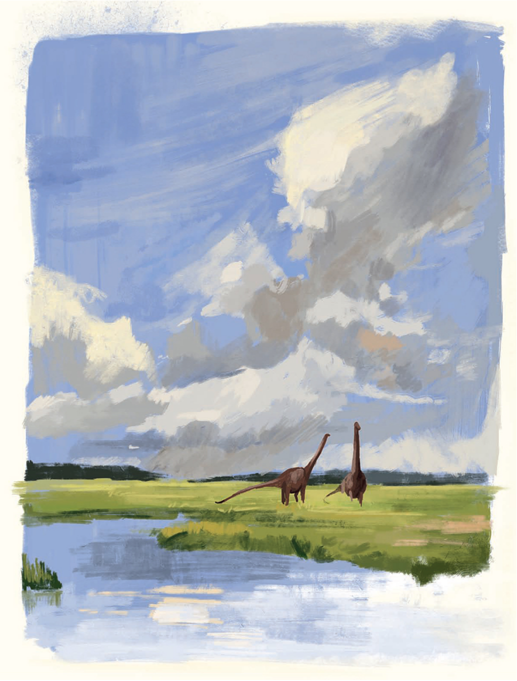
- **Digital | 2022**



AUTUMN STREAM

Thescelosaurus is a bipedal ornithischian from the Late Cretaceous of western North America that probably browsed on leaves and shoots. However, powerfully muscled, robust forelimbs hint at the possibility of it being a capable digger or of using its arms to break or move foliage. The external covering of these dinosaurs is mildly controversial: were they scaly or covered by filaments?

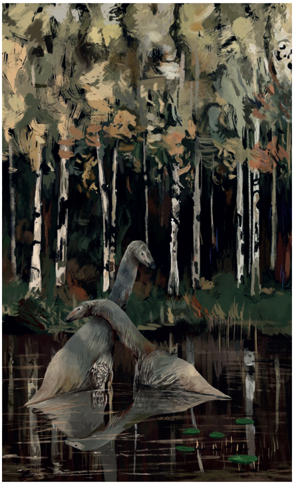
• Digital | 2020



OPEN AIR

Two individuals of the great North American titanosaur *Alamosaurus* are set within an almost impressionistic landscape. This painting started life as a plein cloud study and marks one of Brennan's first forays into using digital brushwork in expressionism and impressionism. It serves as a good example of how art depicting dinosaurs can simply be art, perhaps where the dinosaurs are not even the focus of attention.

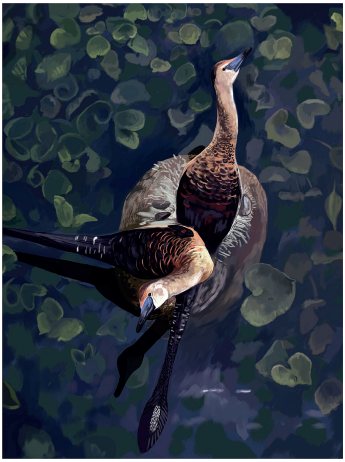
• Digital | 2020



BIRCH REFLECTIONS

Dinosaurs can be portrayed as peaceful animals, set within calm, subdued environments, just as much as any living animal. *Erlikosaurus* is a therizinosaur, a group of unusual theropods noted for their broad bodies, stocky hindlimbs and large hand claws. These features, combined with their tiny teeth and a toothless beak, indicate herbivorous habits.

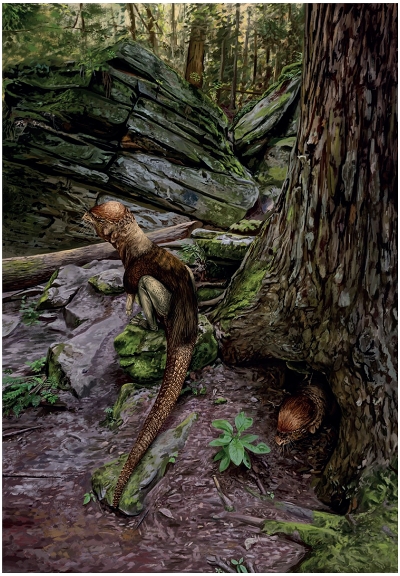
- **Digital | 2020**



VERDANT GLADE

Halszkaraptor from the Late Cretaceous of Mongolia is one of the most surprising and interesting of recently described dinosaurs. A long-necked, short-armed dromaeosaurid similar in size to a duck, it possessed an unusually high number of teeth and other features that suggest amphibious habits.

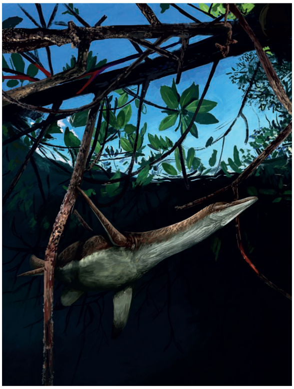
- **Digital | 2019**



THE LEDGES

A pair of the Late Cretaceous North American pachycephalosaur *Alaskacephale* are shown in the complex rocky and forested habitat they might have favoured. These dinosaurs might well have used dens and burrows, and we now think that their tails were thick and muscular. One possibility is that the tail was armoured with tough scales and used as a weapon.

• Digital | 2020

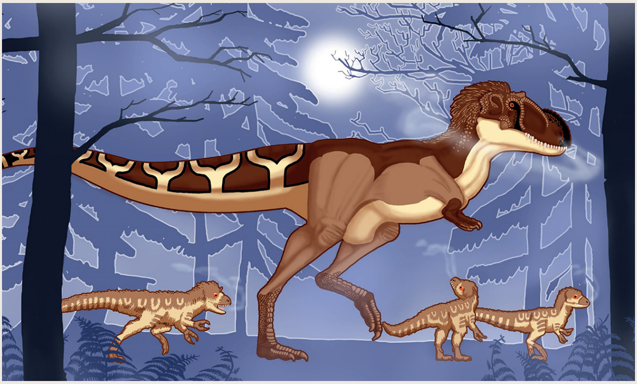


SHELTERED AMONG THE ROOTS
A juvenile *Thililua* – a relatively long-necked, mid-sized polycotylid plesiosaur from the Late Cretaceous of Morocco – swims among the complex root systems of a mangrove forest. Fossils show that plesiosaurs of many kinds frequented estuaries and river mouths, perhaps – in the case of juveniles – as protection from larger predators.

• Digital | 2020

USA

RAVEN AMOS

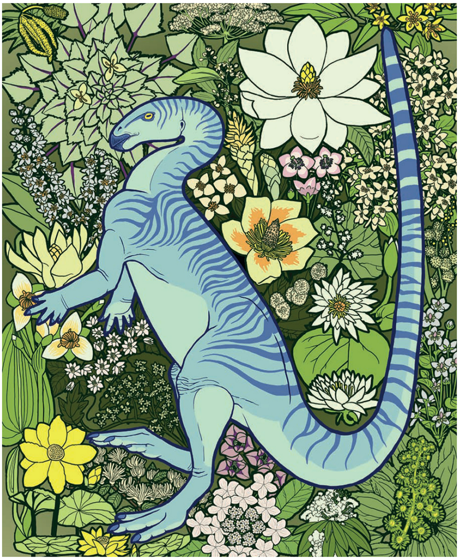


A COLD DAY OUT

A mother *Albertosaurus sarcophagus* and her three chicks in early winter amidst the dawn redwood forests of Late Cretaceous Alaska. The far north of the Late Cretaceous was nowhere near as cold as it is today, but temperatures could still dip below freezing during the winter.

- **Digital | 2011**

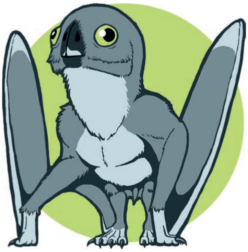
RAVEN AMOS IS AN ALASKAN digital artist born in the era of cheesy animation and far-flung fantasy films. She developed a love of reading, drawing and dinosaurs at an early age, inspired by the illustrations of Robin James, William Stout and Peter Zallinger, and later finding influence in early Art Nouveau-era artists. After job shadowing under Otis 'Scott' McDaniel (1926–2012) in her early teens, Raven experimented with different media, winning awards for watercolour and sculptural works in 1997 and 1998, and for digital art in 2015 and 2018. After studying at the Art Institute of Seattle, Raven returned to Alaska and pursued a career in Graphic Design. Raven met her husband Scott Elyard while working at a newspaper in 2007, where he rekindled her love of dinosaurs and encouraged her to return to illustration. In the years since, Raven and Scott have collaborated on many projects, including museum displays, art shows and murals.



FLOWER DANCE

Parksosaurus warreni – a Late Cretaceous thescelosaurid from Canada – ‘dances’ among flowering plants known from the Cretaceous fossil record of Alaska and Russia. Plant fossils found across the Cretaceous Arctic point to the presence of warm, dense forests that covered the northern extremes of both regions.

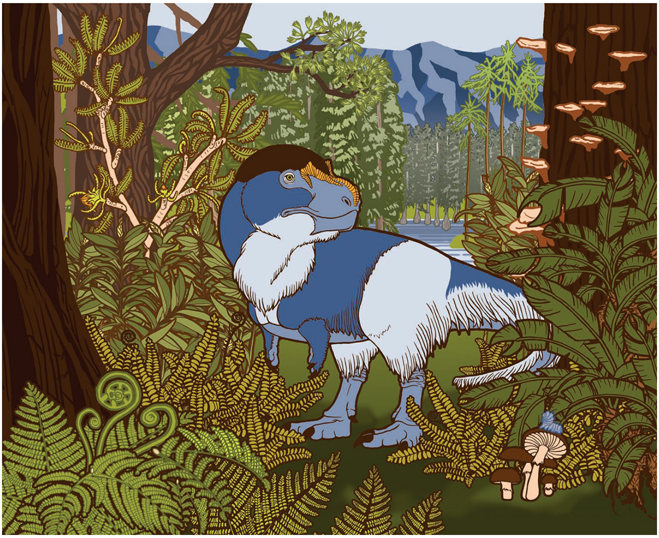
• Digital | 2018



ANUROGNATHUS

Anurognathid pterosaurs were cute, but few people outside the worlds of pterosaur research and palaeoart have ever heard of them. *Anurognathus* – the first member of the group to be recognised – is from the famous Upper Jurassic Solnhofen Limestone of Germany.

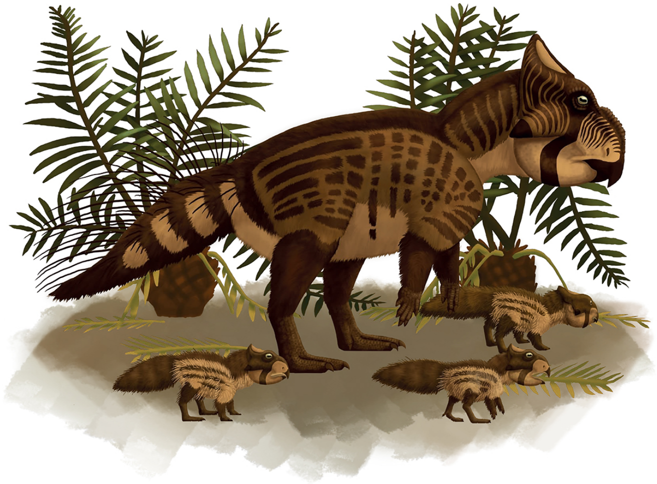
- **Digital | 2015**



ALICE IN WONDERLAND

Nanuqsaurus, named from Alaska in 2014, is a Late Cretaceous tyrannosaurid famed for its association with the far north. Once thought of as 'small' – 5–6m long – new data suggests higher estimates of 8m. This image depicts a juvenile amidst a remnant of a warmer, wetter period where Cretaceous Alaska was dominated by ferns, cycads, bennettitales, dawn redwoods and ginkgos.

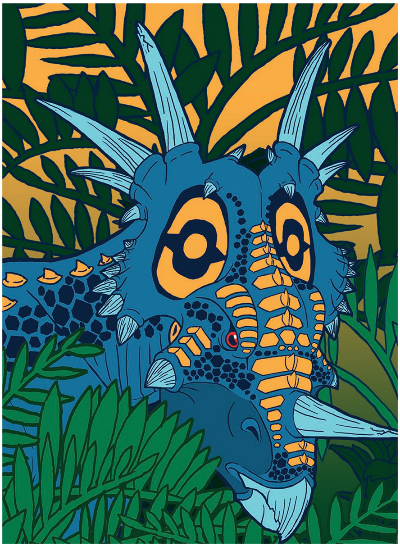
• Digital | 2017



A FALL DAY OUT

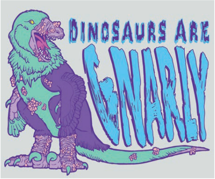
A mother *Ferrisaurus*, a leptoceratopsid, and her three babies forage in the cycad undergrowth on an autumnal day. Leptoceratopsids were deep-snouted, mostly small ceratopsians of Europe, Asia and North America, and some members of the group lived right to the end of the Cretaceous. This painting accompanied the discovery and display of 'Buster' the *Ferrisaurus sustutensis* at the Royal BC Museum in 2019/2020. It is the first non-bird dinosaur to be reported from British Columbia.

• Digital | 2014



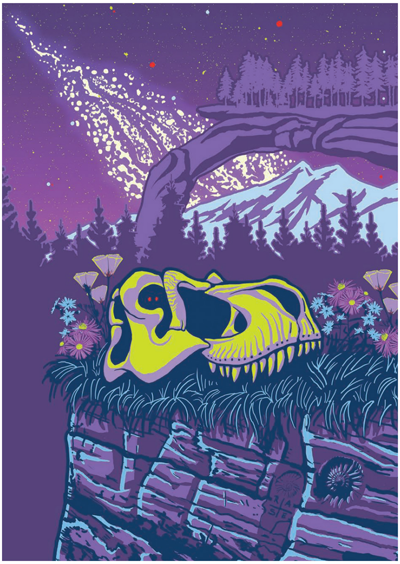
STYRACOSAURUS JUNGLE
Styracosaurus albertensis from the Late Cretaceous of Alberta, Canada, remains one of the most flamboyant and popular of the horned dinosaurs. The six long spikes lining its frill and its long nasal horn remain a unique combination. It appears that these features were part of the animal's display apparatus, as conveyed here through the animal's bold, bright frill and facial markings.

• Mixed media | 2014



DINOSAURS ARE GNARLY
Many dinosaur skeletons reveal old scars and wounds sustained in life, as well as symptoms of disease. This unfortunate *Deinonychus* is suffering from a virulent strain of papillomavirus. Papillomaviruses are widespread in birds today and result in fairly horrific warts and masses of finger-like growths.

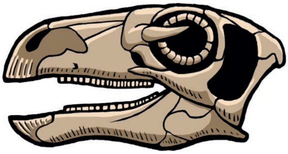
- **Digital | 2017**



LONG LIVE THE KING

The bleached skull of the former Tyrant Lizard King perches on an eroding bluff among the scattered flowers and grasses that have replaced once-plentiful ferns. A streak of bright debris, ejected from the Chicxulub impactor, still arcs across the night sky and a faint glow of dust lingers to reflect the rays of the sinking sun. A joint painting with Scott Elyard.

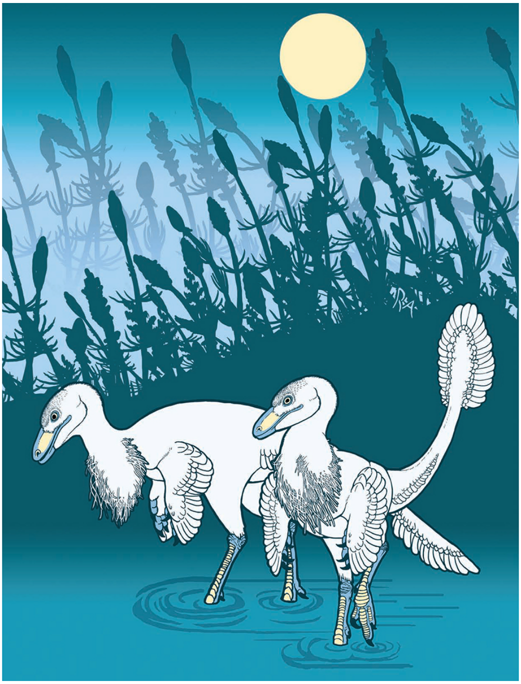
- **Digital | 2018**



***PARKSOSAURUS* SKULL**

In producing this image of a parksosaur skull, Raven drew inspiration from the work of fellow Alaskan and much-loved palaeoartist Ray Troll. The skull is one of a series imagined as emblems of a fictitious local coffee roaster termed ‘Cretaceous Critter Coffee Co.’

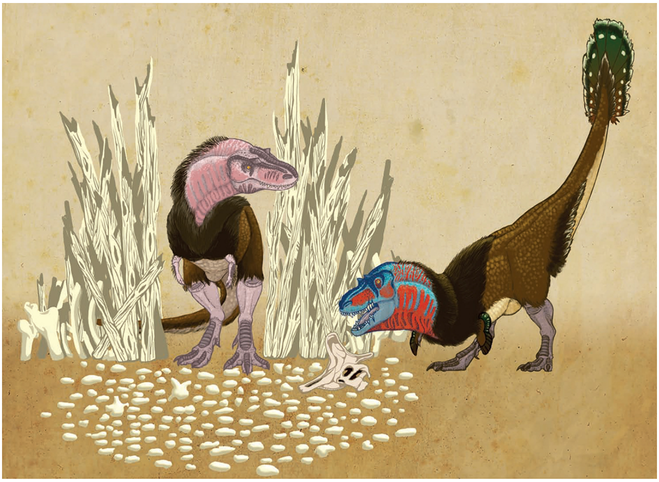
• Digital | 2017



WINTER MOON

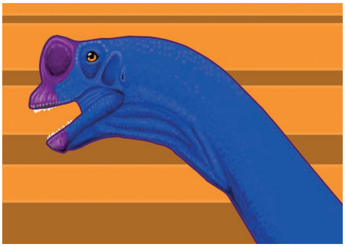
An ukiyo-e (Japanese woodblock art) inspired painting of two *Geminiraptor suarezarum* wading through a seasonal floodplain, hunting under a full moon. *Geminiraptor* is an Early Cretaceous troodontid from Utah, known only from a distinctive and highly pneumatised maxillary bone from the side of the face. It was not large, perhaps less than 1.5m long.

• Digital | 2022



LESSER BOWERTYRANTS/*GORGOSAURUS LIBRATUS*
This highly speculative piece – submitted for the book *All Your Yesterdays* by Darren Naish and C. M. Kösemen – portrays the Late Cretaceous North American tyrannosaurid *Gorgosaurus* as a 'Lesser Bowertyrant'. The males construct bowers of bone and driftwood and offer trophies from hunts or scavenging successes while displaying their iridescent feathers. While some 'avian' behaviours were present among other theropod groups, the fossil record is fickle in what it preserves.

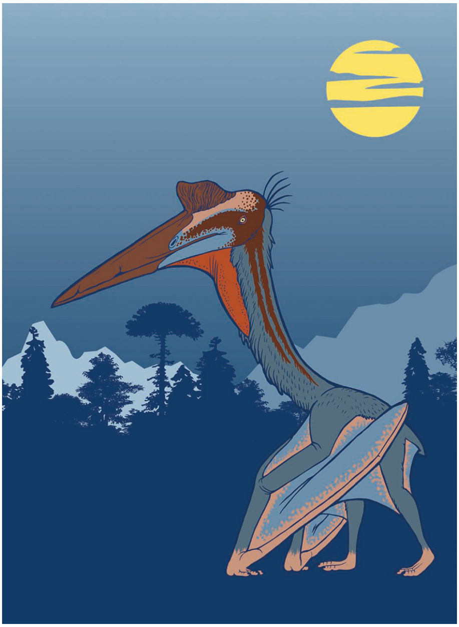
• Digital | 2013



EUROPASAURUS

Using complimentary colours that are opposite hues on the colour wheel, Raven has produced a colour portrait of *Europasaurus holgeri*, an island-dwelling dwarf sauropod that lived in Late Jurassic Germany. Like those of its giant cousins *Giraffatitan* and *Brachiosaurus*, the skull of *Europasaurus* is topped with an arching bony crest that may well have formed the anchor for a bulbous, strongly convex fleshy snout. The colours here might be considered experimental or fun rather than realistic.

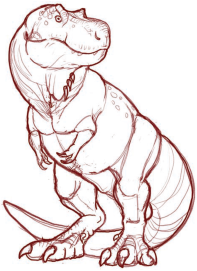
• Digital | 2011



DENALI PTEROSAUR

A large azhdarchid pterosaur patrols the floodplains of what will become Denali National Park, Alaska, in the Late Cretaceous. Raven's art here showcases the key traits of these animals: a stork-like demeanour in the head and neck, an ability to fold the massive wings and walk quadrupedally, and a size that would have made them dangerous to anything smaller than a person.

• Digital | 2017



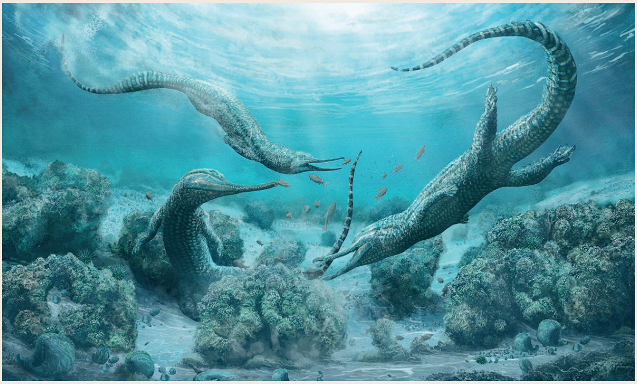
TYRANNOSAUR QUICK SKETCH

This study combines modern views of tyrannosaurs and the aesthetic of vintage dinosaur art. Much of what could be said about tyrannosaur life appearance has been exhausted, but issues worth considering here include how large the display structures on the head were, and how bulky is ‘too’ bulky.

- **Digital | 2019**

UK

MARK WITTON

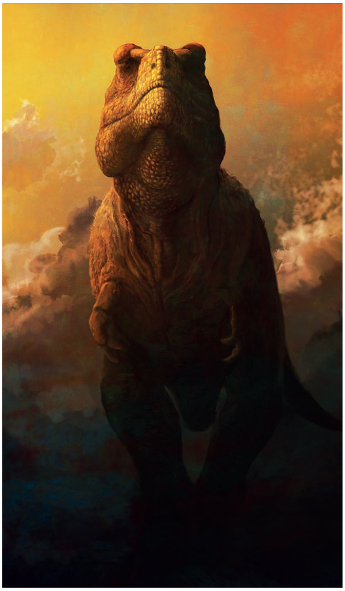


MYSTRIOSUCHUS STEINBERGERI

The phytosaurs were a group of aquatic, superficially crocodile-like reptiles closely related to archosaurs and widespread during the Triassic. Fossils of *Mystriosuchus* from the Late Triassic of Germany, Austria and Italy unusually come from marine sediments, and a 2019 study confirming that it was indeed sea-going. Mark's artwork was included within the technical study concerned.

- **Digital | 2018**

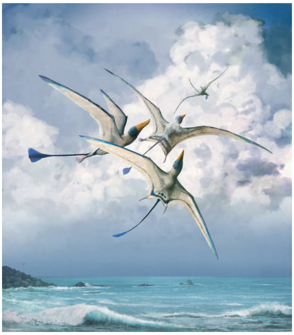
DR MARK P. WITTON is a palaeontologist and palaeoartist based in southern Britain. He is best known for his research on pterosaurs, the life appearance of fossil animals and the history of palaeoart, subjects on which he has authored many technical papers and several books, including *Pterosaurs: Natural History, Evolution, Anatomy* (2013), *The Palaeoartist's Handbook* (2018), *Life Through the Ages II* (2019) and *The Art and Science of the Crystal Palace Dinosaurs* (2022). He has produced artwork for museums and universities around the world, including the American Museum of Natural History and the Natural History Museum, London, and provides consultation and extinct species designs for major documentary makers and film studios, including the *Walking with Dinosaurs* franchise (20th Century Fox, BBC).



TYRANNOSAURUS ROARS... SORT OF

Here Mark challenges the stereotypical idea that big theropods like *Tyrannosaurus* bellowed loudly with an open mouth. This depiction is more probable: this *Tyrannosaurus* bellows with a closed mouth, the inflated throat tissues acting as a resonator to amplify its voice. This sound-production mechanism has evolved repeatedly among living archosaurs, so is entirely possible.

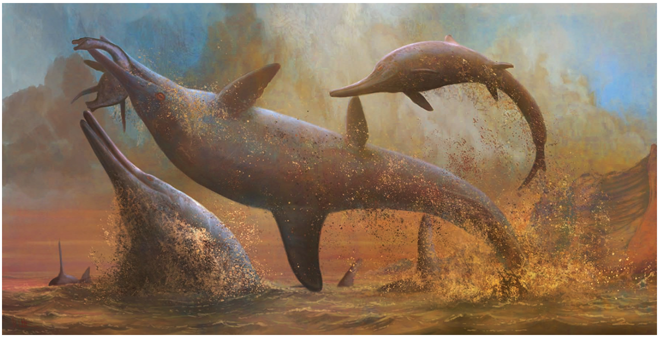
• Digital | 2022



RHAMPHORHYNCHUS MUENSTERI

As well as writing a definitive book on pterosaurs in 2013, Mark has also published research on the locomotion and biology of long-tailed toothed forms like these *Rhamphorhynchus*. Here, a juvenile has caught a fish and is targeted by several piratical adults. The adults are 'mid-sized' pterosaurs, with wingspans of around 1.8m.

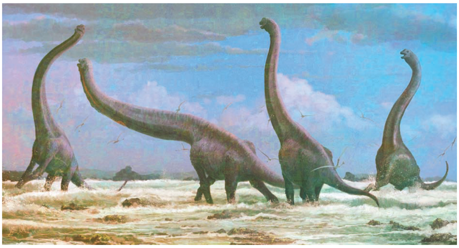
• Digital | 2018



TEMNODONTOSAURUS PLATYODON AND JUVENILE RHOMALEOSAURID

Temnodontosaurus is a (mostly) Western European ichthyosaur of the Early Jurassic, its several species varying in skull shape. *T. platyodon* underwent a major change in jaw shape as it grew, as shown by the juvenile (upper right). *T. platyodon*'s large size (12m, maybe more) and its robust, keeled teeth show it predated vertebrates such as the small rhomaleosaurid plesiosaur shown here.

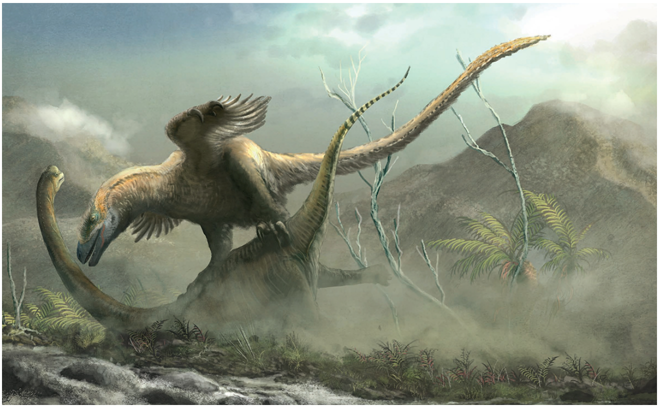
• Digital | 2021



GIRAFFATITAN BRANCAI AT THE COAST

Giraffatitan – the giant macronarian sauropod until recently included within the North American genus *Brachiosaurus* – inhabited Tanzania (and probably elsewhere) during the Late Jurassic. The location that yields *Giraffatitan* – Tendaguru – was a floodplain adjacent to the coastline, so the possibility that it visited beaches and shores is high.

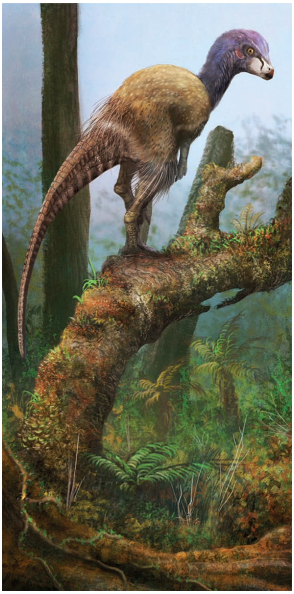
- **Digital | 2021**



DEINONYCHUS ANTIRRHOPUS VS *SAUROPOSEIDON PROTELES*

Much discussion has surrounded the prey preferences and predation techniques of dromaeosaurids. While some evidence indicates that they mostly preyed on small animals, the killing of larger ones – like the juvenile sauropod shown here – was almost certainly within their capabilities. This *Deinonychus* is using the 'raptor prey restraint' technique proposed by Denver Fowler and colleagues in 2011, based on their studies of birds of prey. The next stage is for the sauropod to be eaten alive while the dromaeosaurid weighs it down.

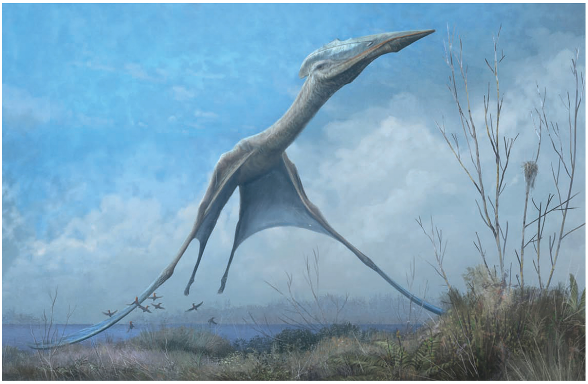
• Digital | 2018



KULINDADROMEUS ZABAIKALICUS

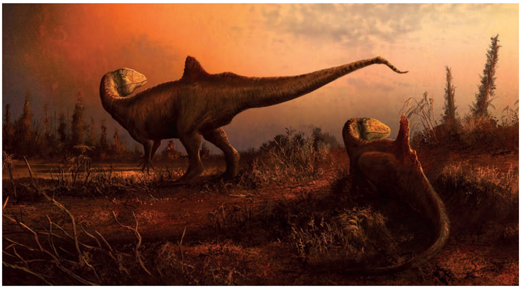
Kulindadromeus from Middle Jurassic Russia really is a 'game-changer' fossil: a small dinosaur preserved with a mosaic of fibres, scales, and several things in between covering its external surface. What if *most* dinosaurs were this varied in integument? Mark has written that this is a real possibility. After all, our knowledge of the integument of most dinosaur groups remains extremely patchy. We await more data.

• Digital | 2020



HATZEGOPTERYX THAMBEMA IN FLIGHT
Ten-metre wings propel one of the largest known flying animals into the sky. *Hatzegopteryx* from Late Cretaceous Romania is one of the best represented of the giant azhdarchids, with bones of most major body regions now known. This image was created to accompany a technical study by Mark on the flight abilities of giant pterosaurs.

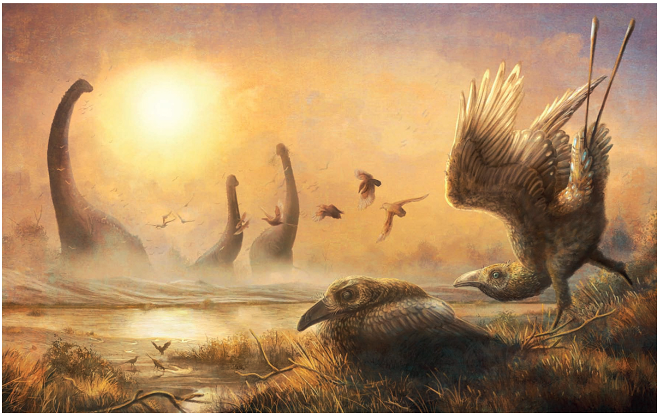
• Digital | 2019



CONCAVENATOR CORCOVATUS

Something has captured the attention of a pair of the Early Cretaceous Spanish theropod *Concavenator.* Why this dinosaur possessed its unusual dorsal sail remains under discussion but a role in visual signalling is probable. This piece expresses a theme common in Mark's illustrations: prehistoric animals were *animals* adapted for their environments. As such, they surely mirrored the textures, shapes and colours of their world.

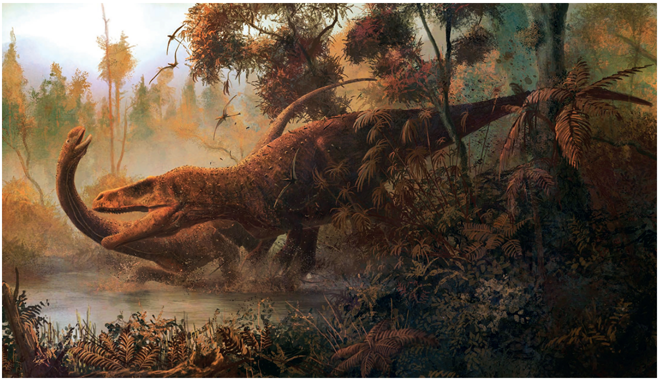
• Digital | 2019



FALCATAKELY FORSTERAE

The enantiornithines or ‘opposite birds’ are the stars of the Mesozoic bird world, their diversity and anatomical innovations regularly surprising researchers. *Falcatakely* from the Late Cretaceous of Madagascar was announced in 2020 and is radically odd – its deep, curved rostrum superficially recalling that of a toucan. This artwork – produced to announce *Falcatakely*’s publication – contrasts the crow-like size of this bird with that of the big titanosaurian sauropods that shared its habitat.

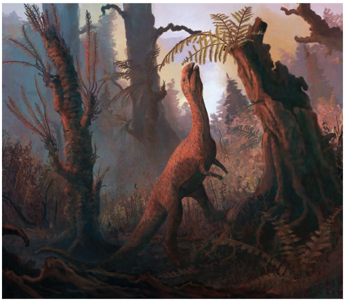
• Digital | 2020



MEGALOSAURUS BUCKLANDII* VS *CETIOSAURUS OXONIENSIS

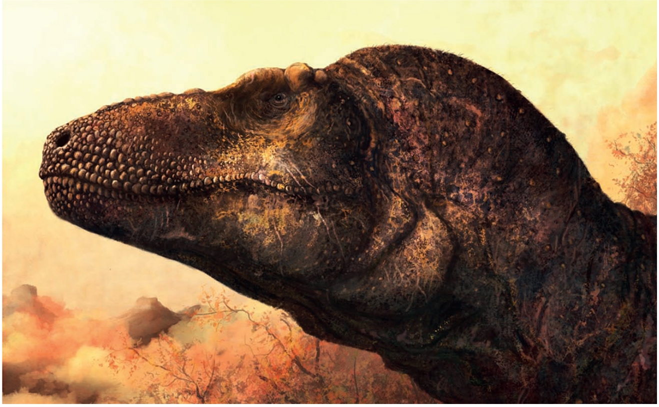
Artwork depicting *Megalosaurus* and *Cetiosaurus* of Middle Jurassic England – two of the very first non-bird dinosaurs to be scientifically recognised – is now unfashionable. As vintage dinosaurs, they're often considered less interesting than the scores of similar types discovered since. In reality, both were surely complex and fascinating animals no matter how 'familiar' they might seem, and they remain fresh subjects for palaeoart.

- **Digital | 2020**



A NEW LOOK FOR *EFFIGIA OKEEFFEAE*
Certain crocodile-line archosaurs of the Triassic convergently evolved morphologies presaging later dinosaur groups. *Effigia* from the Late Triassic of the United States was a toothless biped with delicate forelimbs that superficially resembled a theropod. This image accompanied a 2021 study that recognised *Effigia*'s toothless snout and jaws to be more downturned and bird-like than previously realised.

• Digital | 2021



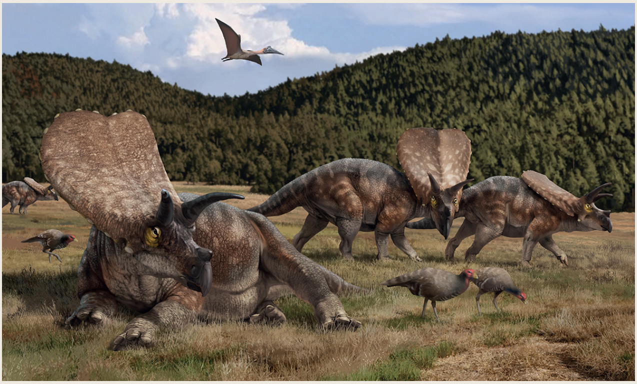
***T. REX* PORTRAIT**

This image attempts to rationalise details of the facial integument of *T. rex*, perhaps the most depicted face in all of palaeoartistry, from the textures of the underlying skull bones. Sheathed teeth and thick, keratinous bosses and lumps above the eyes are present, as are specific details of armour and scalation around the eyes and snout.

• Digital | 2021

PERU

JAIME CHIRINOS

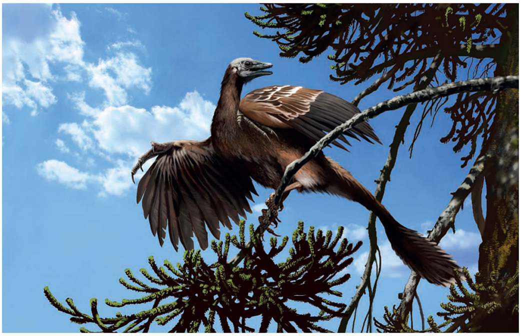


TOROSAURUS LATUS
A group of the gigantic Late Cretaceous horned dinosaur *Torosaurus* relax in a clearing dominated by grass-like flora in western North America. The claim that *Torosaurus* is the ‘old adult’ of *Triceratops* is contested by the majority of experts, and *Torosaurus* is here depicted as its own, distinct taxon. Gallinaceous birds forage nearby – ancestors of today’s pheasants, turkeys and chickens. A giant azhdarchid pterosaur soars overhead.

- **Digital | 2021**

NOW AN ALUMNUS of New York’s School of Visual Arts, Jaime’s initial inspiration was a unhealthy diet of too many *Godzilla* movies and sci-fi cartoons from the 1970s and 1980s. His enthusiasm for all things monstrous led to a burgeoning talent as an illustrator of animals both real and imagined, while inspiration from such venerable palaeoartists as Mark Hallett, James Gurney, Gregory Paul and Raúl Martin led to

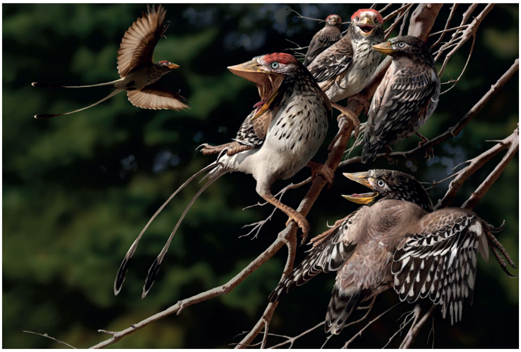
Jaime's work appearing in numerous publications such as *Science Illustrated*, books by Scholastic, the BBC's Natural History website and the National Geographic series *Monster Fish*. He currently resides in the Washington DC metropolitan area.



ARCHAEOPTERYX

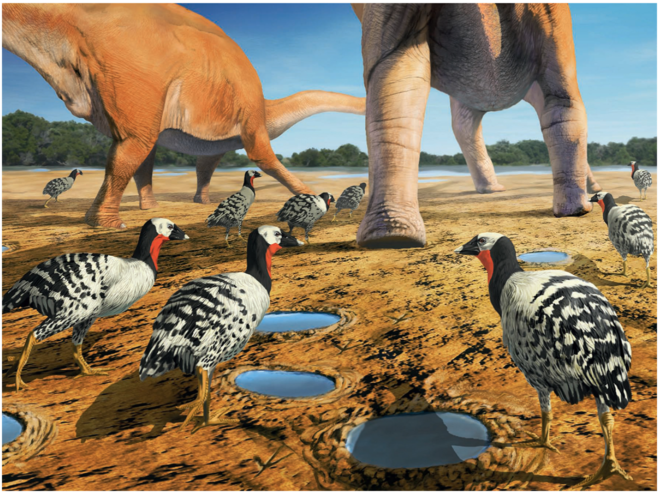
Archaeopteryx – the iconic 'early bird' of Late Jurassic Germany – was approximately raven-sized; it was long-tailed, with tooth-bearing jaws, and claws on all three of its fingers. This reconstruction harks back to 'traditional' images showing it perching in trees, with the mostly brown plumage typical of a forest-dweller, and with the fingers 'separate' from the wing feathers.

- **Digital | 2015**



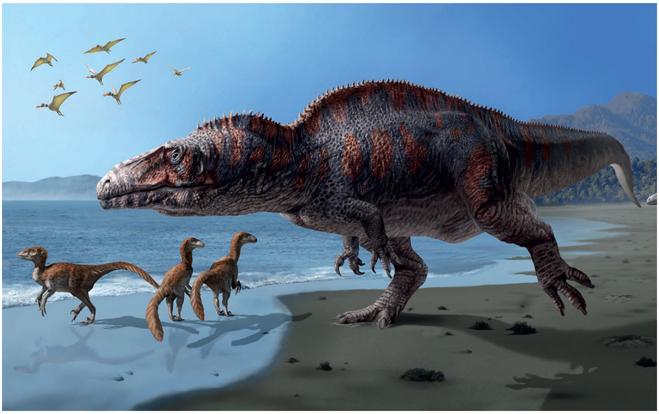
CONFUCIUSORNIS
Scientifically described in 1995, *Confuciusornis* from the Early Cretaceous of China helped fill a gap between Jurassic birds and the more ‘modern’ birds of the Late Cretaceous. Huge numbers of *Confuciusornis* are known today, showing that it was social, lived in forested environments around small lakes, and that the males possessed a pair of tail streamers. Some specimens also show that fish were consumed on occasion.

• Digital | 2015



PATAGOPTERYX
By the Late Cretaceous, birds were abundant and diverse components of terrestrial ecosystems. *Patagopteryx* from Argentina is a chicken-sized flightless species only distantly related to modern birds. Various skeletal features indicate it had flying ancestors. It lived alongside an impressive collection of terrestrial crocodylomorphs, titanosaurs, abelisaurs and ornithischians.

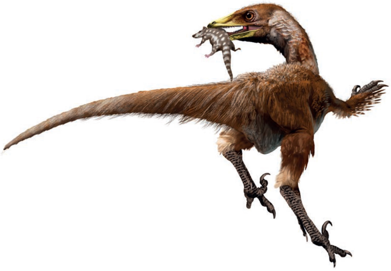
- **Digital | 2015**



ACROCANTHOSAURUS

A group of feathered maniraptorans move away from an *Acrocanthosaurus* on the shores of an inland seaway during the Early Cretaceous. This gigantic carcharodontosaurid theropod – 11.5m long and more than 6 tonnes in weight – is known (so far) from south-western United States. Its most distinctive feature is the extended neural spines on its neck and back vertebrae. These seem to have supported a raised muscular ridge like the withers on a bison, the function of which remains unknown.

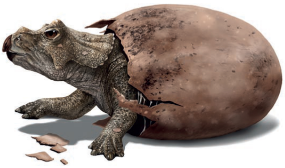
- **Digital | 2015**



STENONYCHOSAURUS

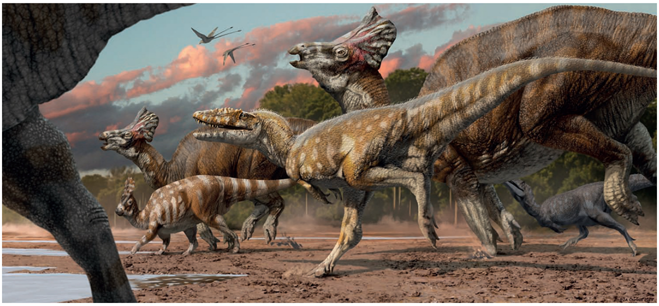
The Late Cretaceous Canadian troodontid theropod *Stenonychosaurus* with mammalian prey. Fossils from China and an affinity with dromaeosaurids and other groups show that troodontids were fully feathered, although the extent of the feathering is unclear. Troodontids were generally 2–3m long and perhaps 1m in standing height.

• Digital | 2015



TRICERATOPS HATCHLING
Little is known about the nesting behaviour and early life of *Triceratops*. A few fragments referable to very young specimens have been announced, but the best fossils relate to individuals that were already around a year old and around 1m long. Hatchlings such as the one illustrated here are unknown, so this reconstruction is speculative.

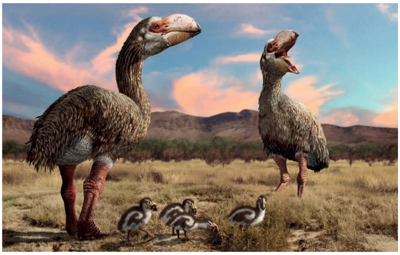
• Digital | 2010



ALIORAMUS HUNT

In this Late Cretaceous East Asian scene, the long-snouted tyrannosaurid *Alioramus* is hunting a large lambeosaurine hadrosaur modelled on *Olorotitan* from the Amur Region of Russia. *Alioramus* is part of a tyrannosaurid group – Alioramini – that's distinct from, but still close to, the group that includes great tyrannosaurids such as *T. rex*.

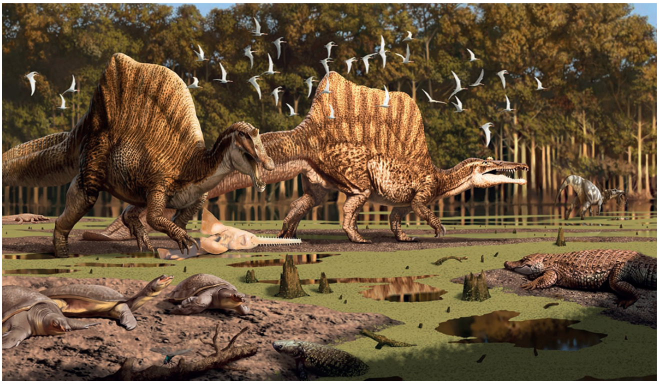
• Digital | 2018



DROMORNIS

A pair of the gigantic *Dromornis stirtoni* – one of the biggest birds of all time – wanders the landscape of the Australian Miocene with their attractively patterned chicks. Despite appearances, *Dromornis* and its kin – the dromornithids or mihirungs – are not closely related to other, similarly-shaped birds from the fossil record (like the gastornithids and phorusrhacids). They are instead allied to anseriforms – the wildfowl. This affinity would surely have affected some aspects of their life appearance.

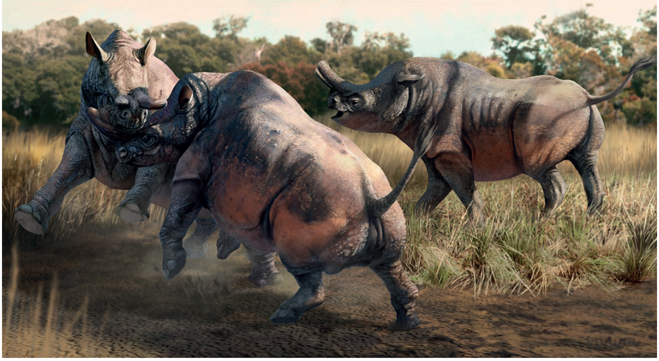
• Digital | 2016



SPINOSAURUS

It is a cliché at this point to refer to changing views on the possible life appearance of *Spinosaurus*. This scene doesn't show *Spinosaurus* swimming or wading, but it is in a wetland setting, has the '2020' deep tail and '2014' 'M-shaped' sail, and is shown as a predator of giant fishes. Crocodylomorphs, turtles, pterosaurs and even a cheeky lungfish occupy the scene too – a reminder that the environments frequented by *Spinosaurus* had a rich and diverse fauna.

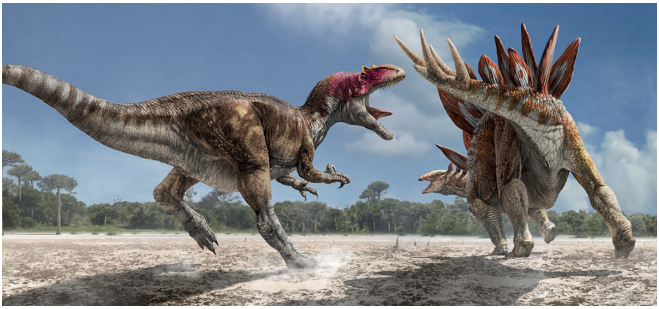
- **Digital | 2021**



MEGACEROPS

Megacerops – the most famous and among the largest of the brontotheres – has a complex taxonomic history, and it is now agreed that the animals formerly known as *Brontotherium*, *Brontops* and *Titanotherium* are all different names for *Megacerops*. Its horn-form is variable, but the biggest individuals have V- or Y-shaped horns. This animal was huge, reaching 2.5m at the shoulder and weighing perhaps 3 tonnes. Direct evidence that these animals fought one another by jousting and barging comes from broken ribs and injuries to the skulls.

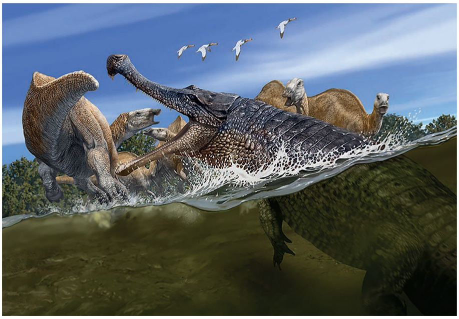
• Digital | 2016



ALLOSAURUS* VS *STEGOSAURUS

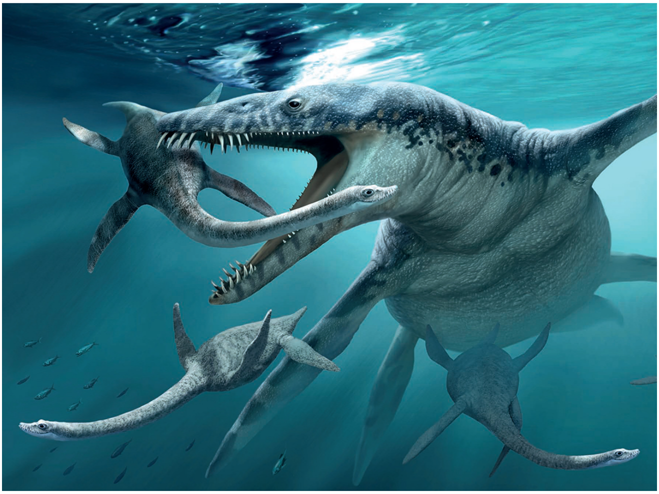
Direct evidence that these two famous North American Late Jurassic animals fought each other comes from preserved injuries. *Allosaurus* specimens with puncture wounds apparently made by *Stegosaurus* tail spines are known, while *Stegosaurus* specimens bear what look like *Allosaurus* bite marks.

- **Digital | 2018**



SARCOSUCHUS IMPERATOR
The giant Early Cretaceous pholidosaur *Sarcosuchus* ambushing an iguanodontian. *Sarcosuchus* reached at least 9m in length, making it one of the largest crocodyliforms ever. It is an unusual, super-sized member of its group, since most pholidosaurs were far smaller and slimmer-snouted. Unsurprisingly for a 'giant-killer', it evolved a broader, more robust snout than its relatives.

• Digital | 2015



LIOPLEURODON
In the seas of Late Jurassic Western Europe, the giant thalassophoneon pliosaurid *Liopleurodon* hunts the plesiosaur *Attenborosaurus*. *Liopleurodon* was more than 7m long – not quite the 20m giant of *Walking with Dinosaurs*, but respectable enough. Evidence that it preyed on other plesiosaurs comes from preserved bite marks on their bones.

• Digital | 2017

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(Jacket, front cover)
ROBBERY
In a speculative scene from Late Cretaceous North America, a flock of *Ichthyornis dispar* harass the pterosaur *Pteranodon sterbergi* into dropping its catch – a behaviour seen in many modern birds.
• Jaime Chirinos, Digital | 2015